Periprosthetic Fractures in the Elderly

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Center for Orthopedic Research and Education®

THE UNIVERSITY OF ARIZONA

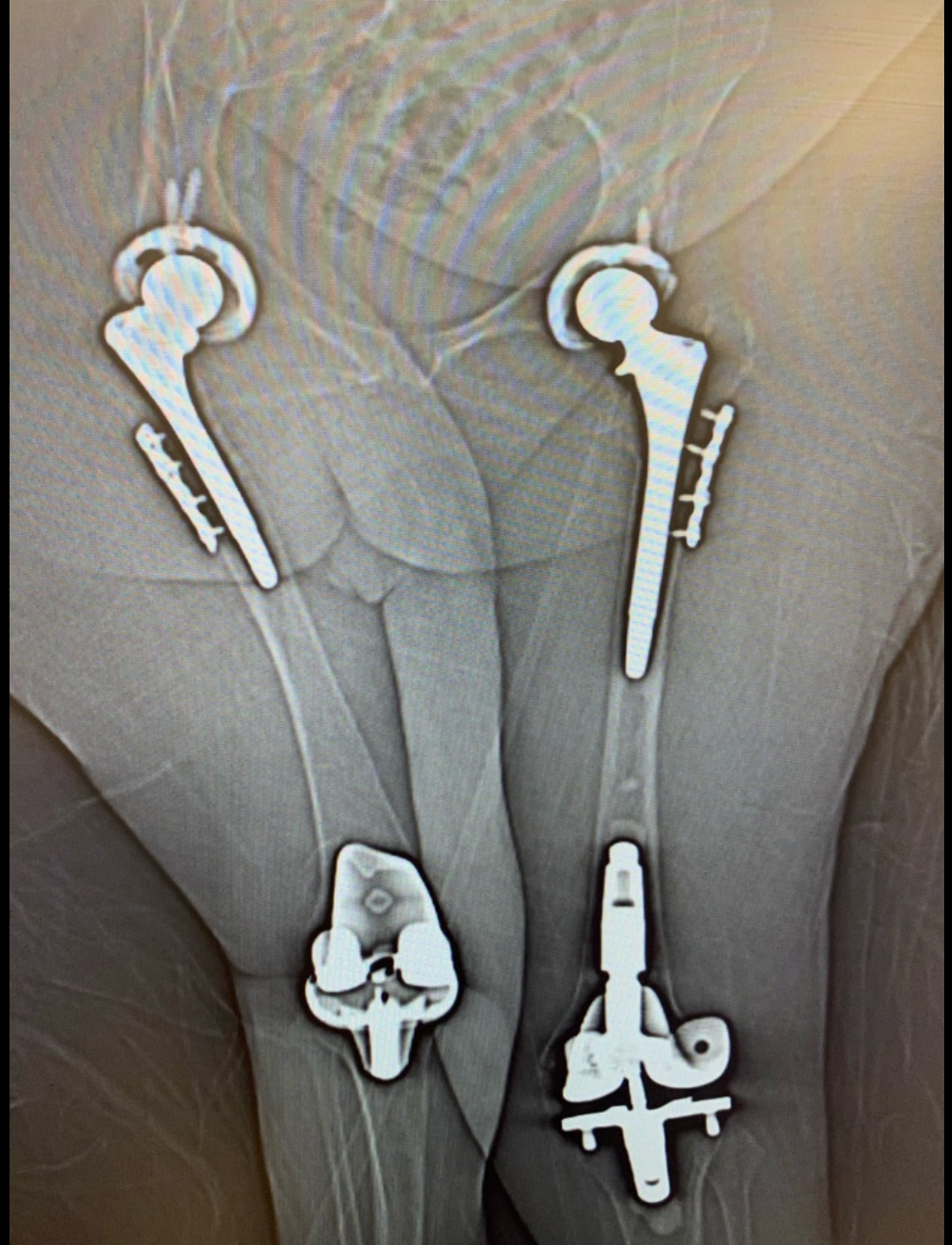
Disclosures

- I, Dr. Niloofar Dehghan, am a consultant for:
  - Stryker
  - Acumed
  - ITS

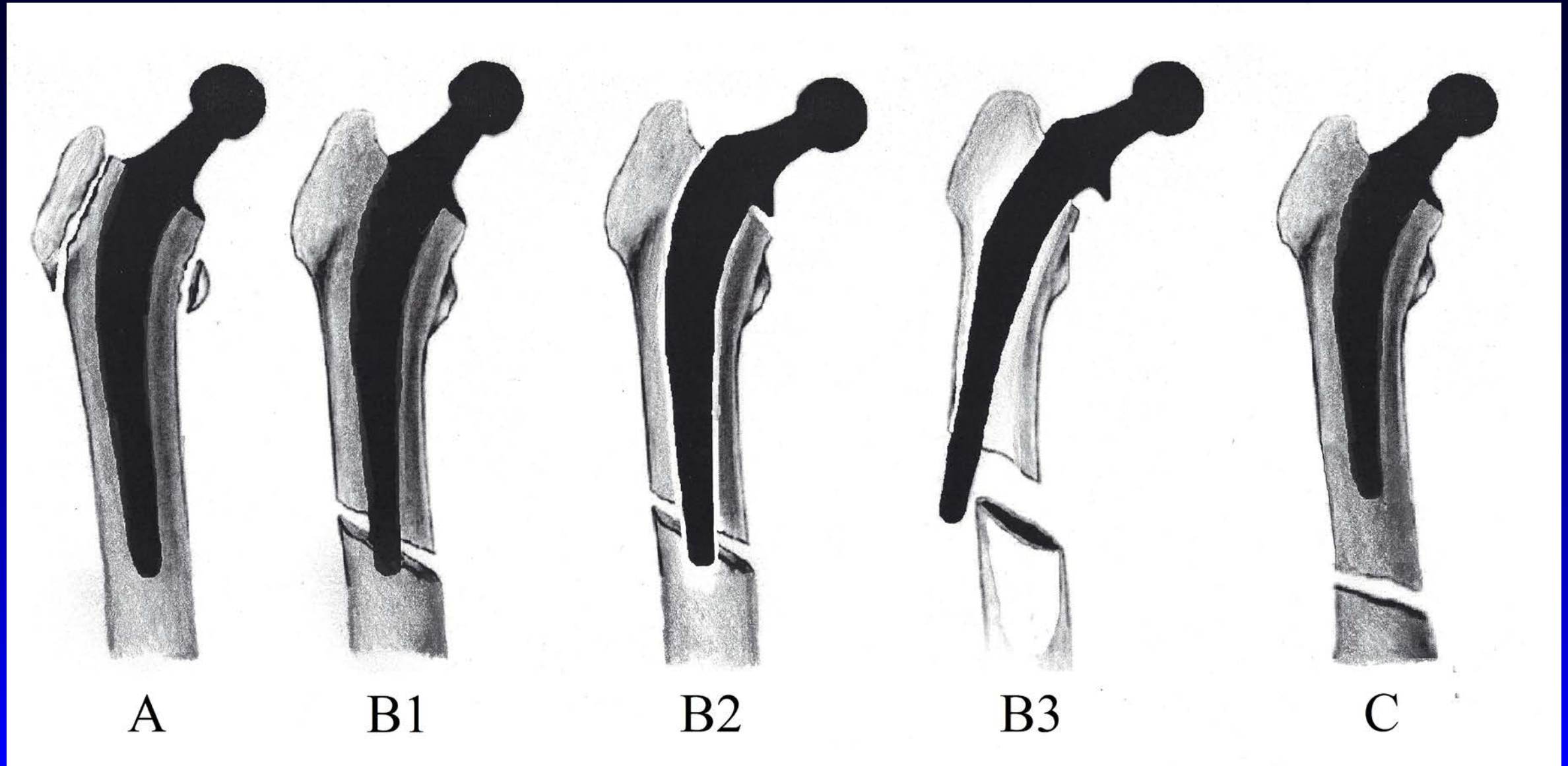
Introduction

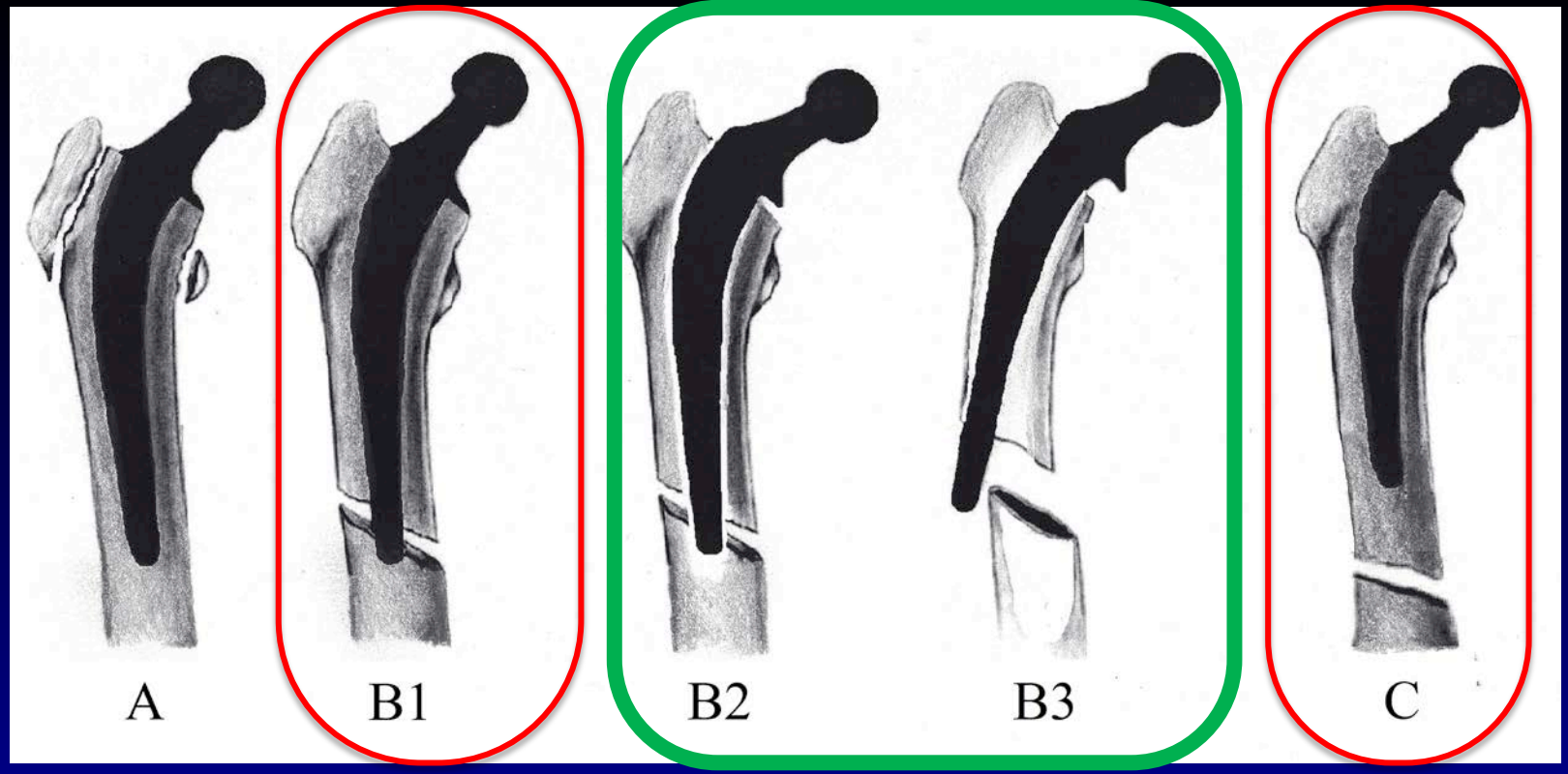
- Periprosthetic fractures are a devastating complication of hip and knee arthroplasty

- Prevalence of these fractures is increasing:
  - Increase in arthroplasty procedures
  - Increase in age, activity, and survival of patients



Vancouver Classification





- Fractures with stable implants (type B1, C) can be treated with open reduction internal fixation (ORIF)
- Fractures associated with a loose prosthesis (types B2,B3) should be revised with a longer prosthesis

1. If the stem is stable, fix it!

2. If the stem is loose, revise it!

What's the issue with periprosthetic fractures?

- They are hard to fix
  - Minimal proximal bone quality proximally
  - Poor bone quality overall
  - Fixation failure is an issue

- Revision
  - needs longer components for distal fixation
  - Longer/more complex procedures with higher complications
  - May have to revise the acetabulum
  - Can have instability/impingement

Treatment options:

1. Prevent them!
2. If the stem is stable, fix it!
3. If the stem is loose, revise it!

1. How do you prevent them?

- Higher rate of fractures in uncemented vs. cemented hip stems
- Avoid stress risers with stemmed implants
- Span the whole bone in high risk patients

Higher rate of fractures in uncemented vs. cemented hips

- **Intra-op fractures:**
  - Primary THA: 0.3% cemented, 5% uncemented
  - Revision THA: 4% cemented, 21% uncemented
- **Post-op fractures**
  - Cemented hemi 0.9%
  - Uncemented hemi 7.4%

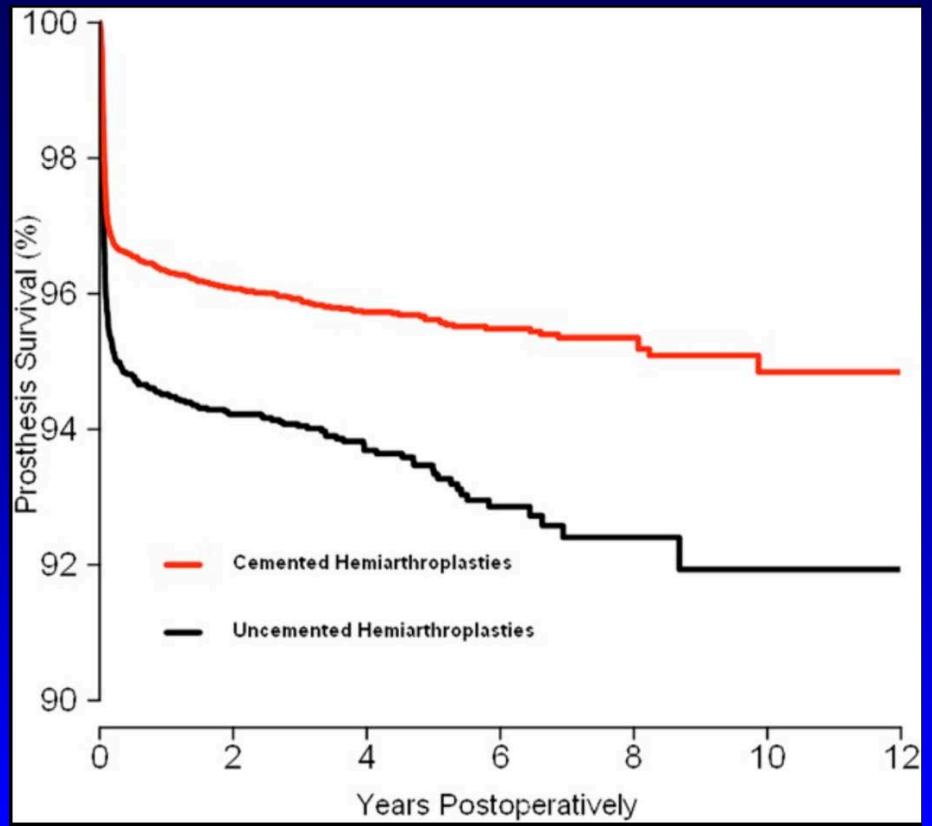
Geriatr Orthop Surg Rehabil. 2012 Sep; 3(3): 107–120, Langslet et al, Clin Orthop Relat Res, 2014)

Clin Orthop Relat Res. 2020 Jan;478(1):90-100. doi: 10.1097/CORR.0000000000000826.

Cemented or Uncemented Hemiarthroplasty for Femoral Neck Fracture? Data from the Norwegian Hip Fracture Register

Torbjørn B Kristensen [1 2], Eva Dybvik [1], Målfrid Kristoffersen [1 2], Håvard Dale [1 2], Lars Birger Engesæter [1], Ove Furnes [1 2], Jan-Erik Gjertsen [1 2]

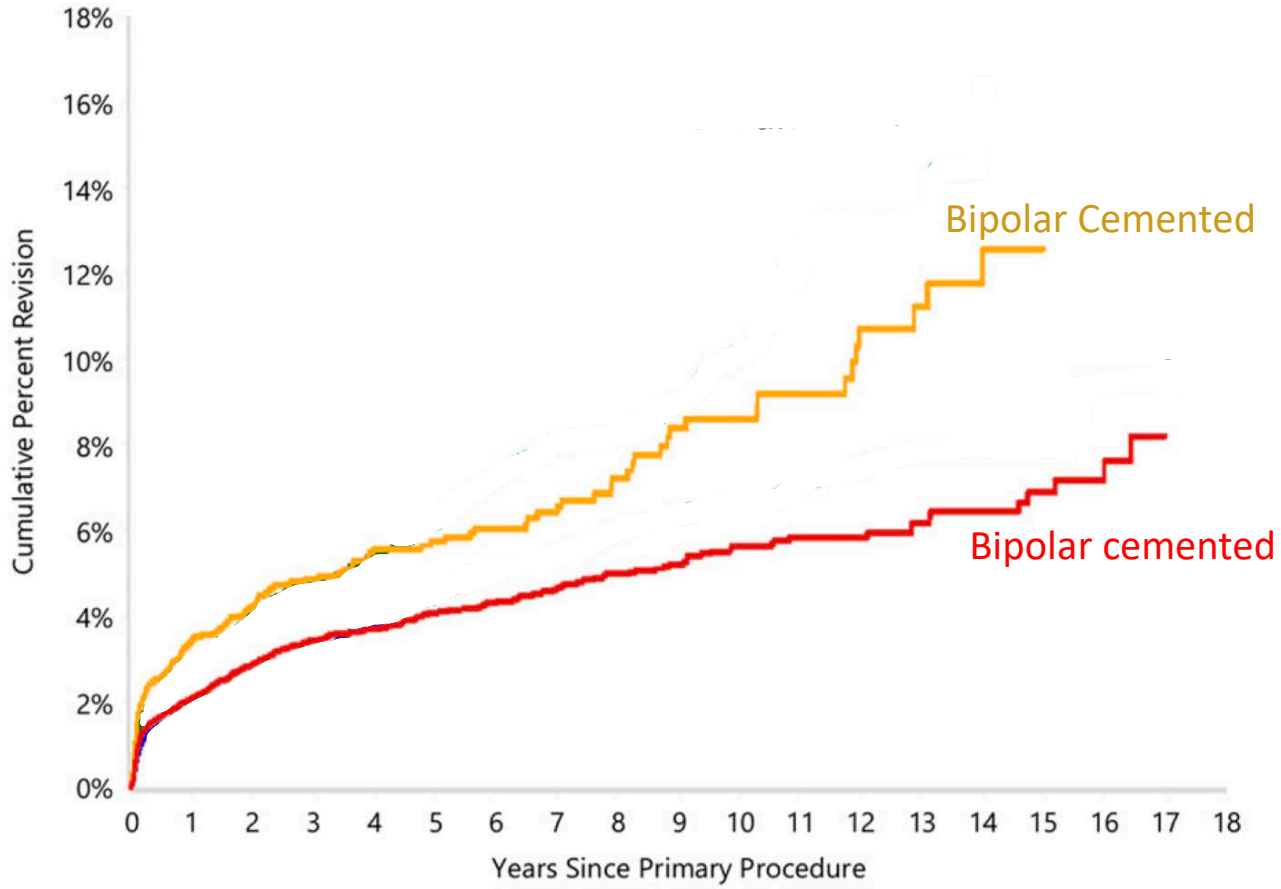
- 98,000 hemi arthroplasties
- Lower risk of re-operation in cemented vs. uncemented:
  - For any reason HR 1.5 P<0.001
  - **For fracture HR 5.1 <0.001**



Revision Risk After Unipolar or Bipolar Hemiarthroplasty for Femoral Neck Fractures

An Instrumental Variable Analysis of 62,875 Procedures from the Australian Orthopaedic Association National Joint Replacement Registry

John E. Farey, MBBS(Hons), MMed(ClinEpi), Alana R. Cuthbert, BMathSc(Hons),
Sam Adie, MBBS, MPH, PhD, FRACS(Orth), and Ian A. Harris, MBBS, MMed(ClinEpi), PhD, FRACS(Orth)



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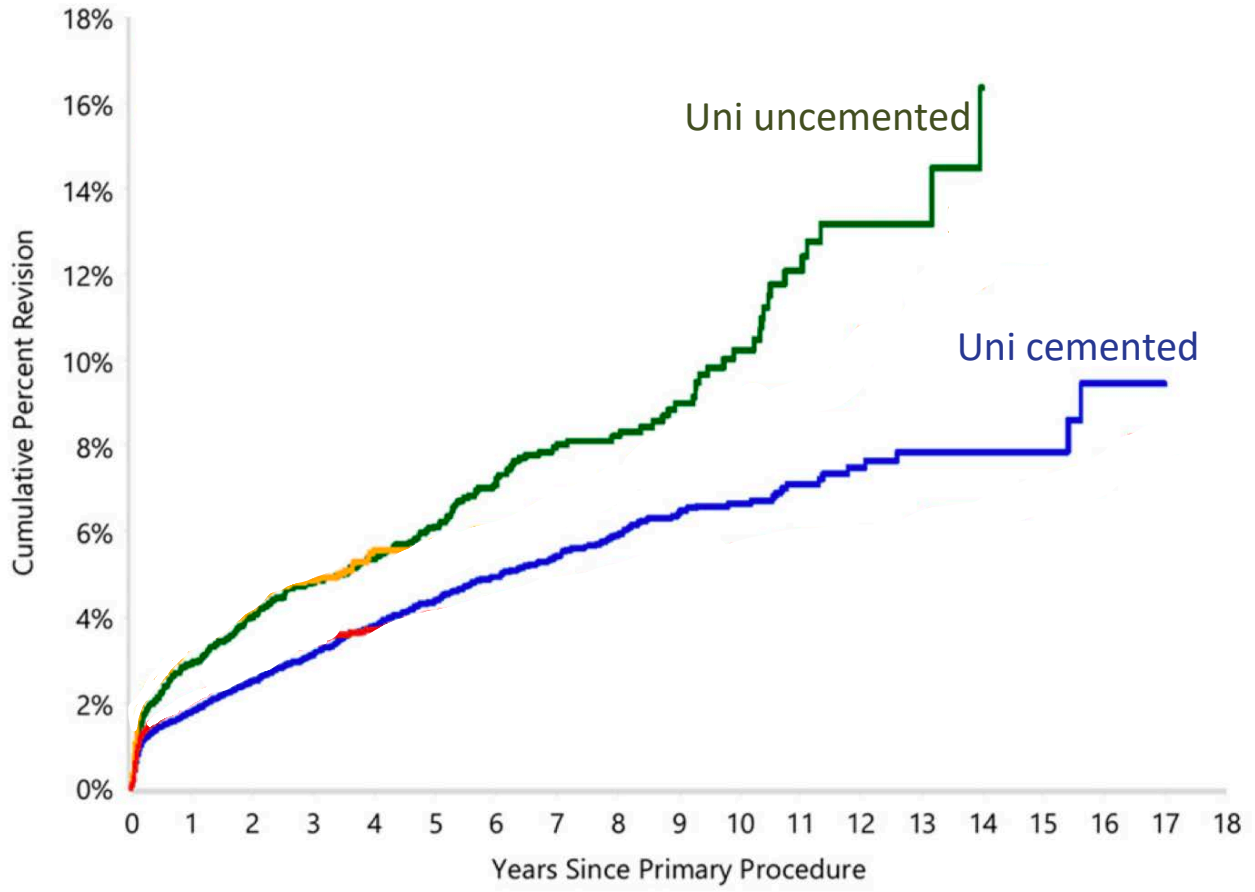


> Clin Orthop Relat Res. 2021 Oct 1;479(10):2194-2202. doi: 10.1097/CORR.0000000000001932.

Cementless Fixation Is Associated With Increased Risk of Early and All-Time Revision After Hemiarthroplasty But Not After THA for Femoral Neck Fracture: Results From the American Joint Replacement Registry

James I Huddleston 3rd [1], Ayushmita De [2], Heena Jaffri [2], John W Barrington [3], Paul J Duwelius [4], Bryan D Springer [5]

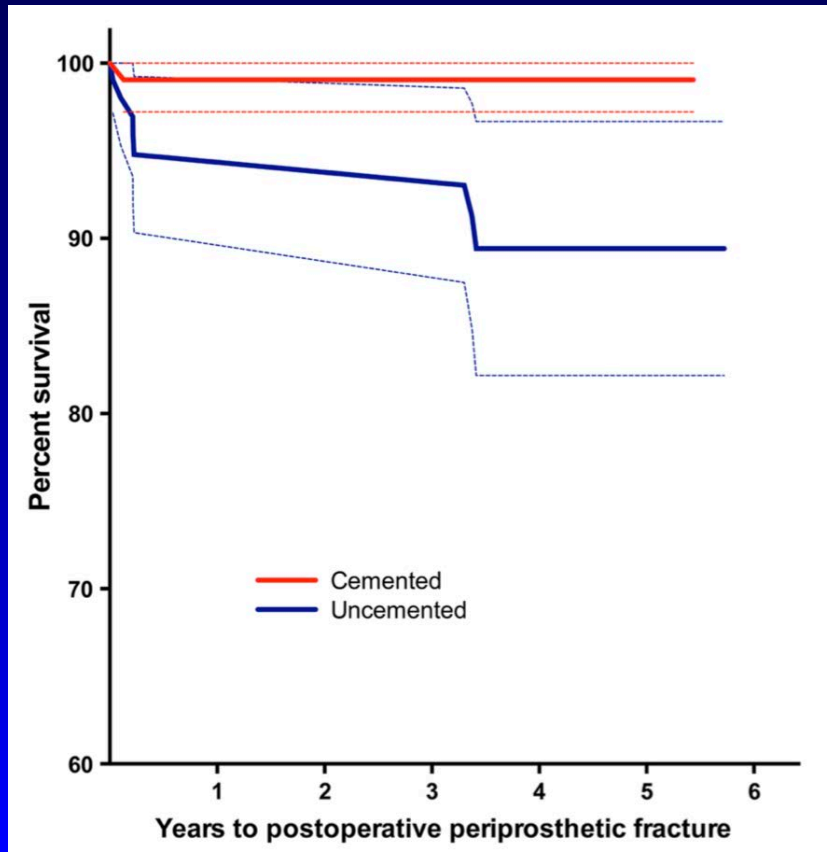
- Hemiarthroplasty cementless vs. cemented:
  - Risk for **any revision**: OR 1.4 ($p < 0.001$)
  - Risk for **early revision**: OR 1.8 ($p < 0.001$)
  - Risk for **revision for periprosthetic fracture**: OR 6.2 ($p < 0.001$)
  - Risk for **early revision for periprosthetic fracture:** OR 7.4 ($p < 0.001$)
- THA: No associations

Randomized Controlled Trial > Clin Orthop Relat Res. 2014 Apr;472(4):1291-9.
doi: 10.1007/s11999-013-3308-9. Epub 2013 Oct 1.

Cemented versus uncemented hemiarthroplasty for displaced femoral neck fractures: 5-year followup of a randomized trial

Ellen Langslet [1], Frede Frihagen, Vidar Opland, Jan Erik Madsen, Lars Nordsletten, Wender Figved

- Post-op periprosthetic fractures:
  - 0.9% in cemented
  - 7.4% in uncemented
  - HR 9.3, p=0.035



Systematic Review and Meta-Analysis

Medicine®

OPEN

Cemented versus uncemented hemiarthroplasty for displaced femoral neck fractures

A meta-analysis of randomized controlled trails

Feng Fei Lin, MD[a,b,*], Yi Fang Chen, MD[b], Bin Chen, MD[a], Chao Hui Lin, MD[a], Ke Zheng, MD[a]

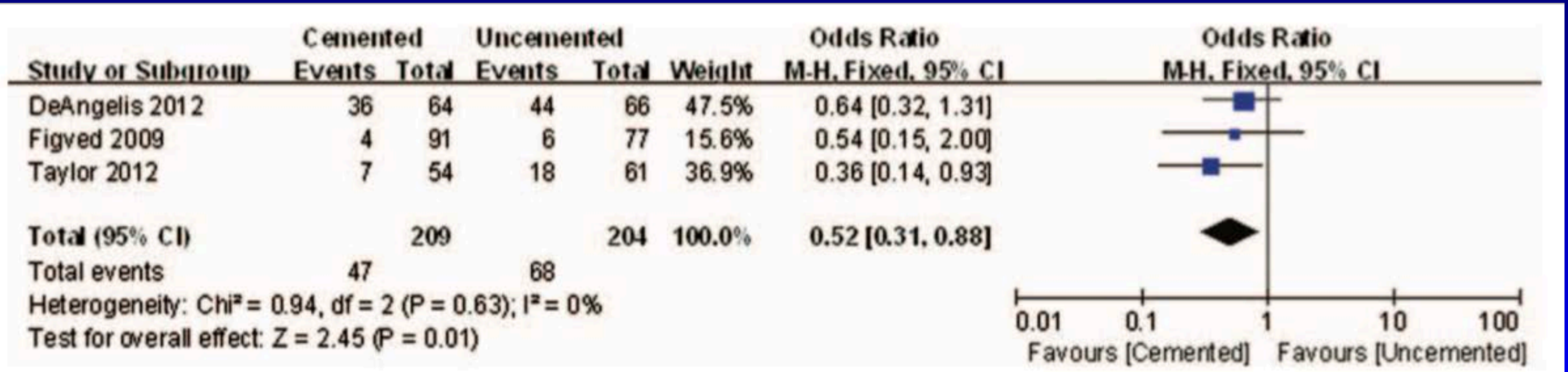


Figure 4. The graph shows a forest plot of relative risk with a confidence interval for postoperative hip function.

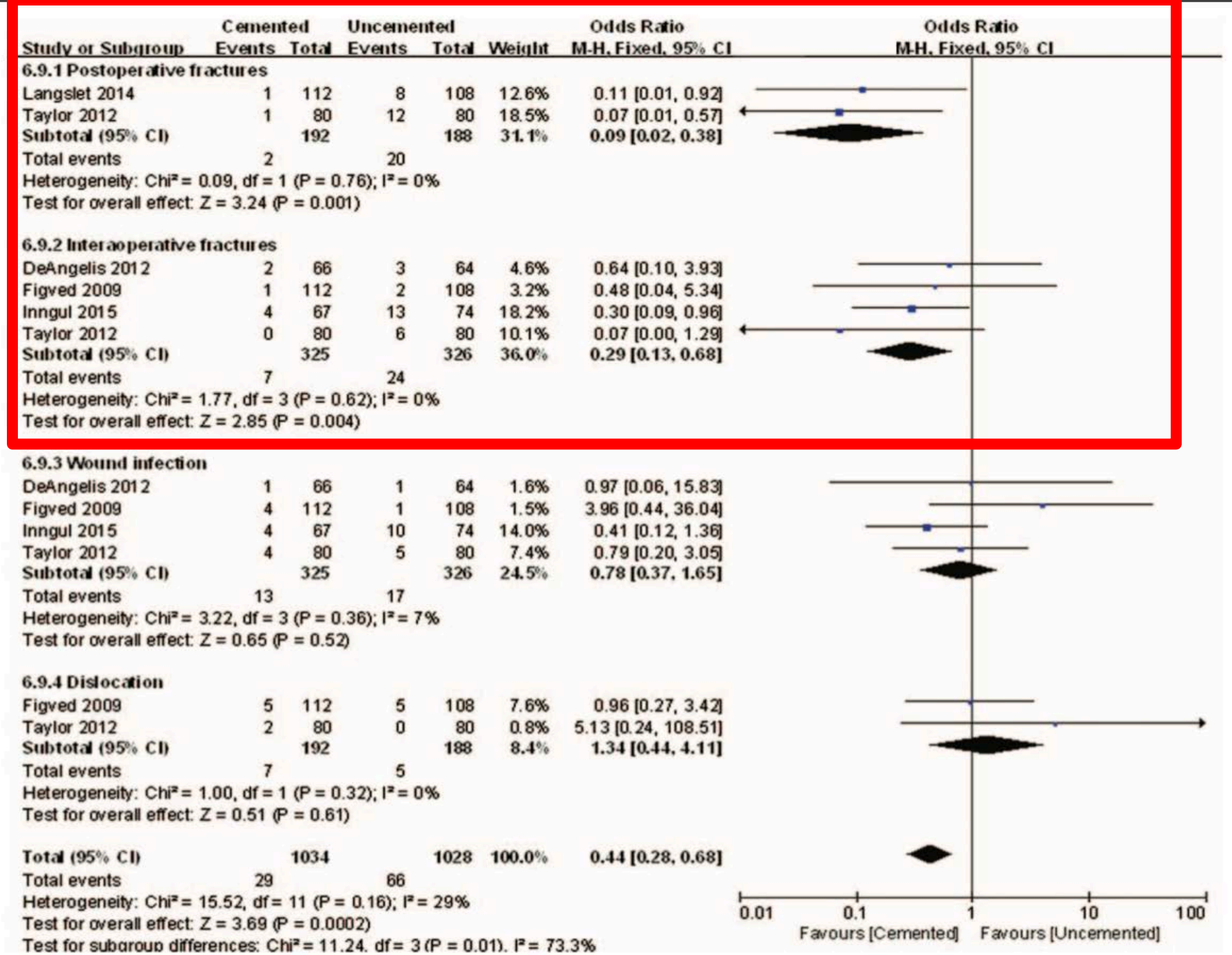


Figure 9. The graph shows a forest plot of relative risk with a confidence interval for local complications.

Less OR time with uncemented?

Study or Subgroup	Cemented Mean	SD	Total	Uncemented Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
DeAngelis 2012	108.2	30.8	66	103.6	32	64	6.0%	4.60 [-6.20, 15.40]
Inngul 2015	82	27	67	80	18	74	12.0%	2.00 [-5.66, 9.66]
Langslet 2014	82.6	19.8	112	70.2	19.3	108	26.3%	12.40 [7.23, 17.57]
Moroni 2009	77	12	22	72	13	18	11.5%	5.00 [-2.82, 12.82]
Talsnes 2013	84	30	162	71	22	172	21.8%	13.00 [7.33, 18.67]
Taylor 2012	79.3	17.2	80	74.7	18.8	80	22.5%	4.60 [-0.98, 10.18]
Total (95% CI)			**509**			**516**	**100.0%**	**8.22 [5.57, 10.86]**

Heterogeneity: Chi² = 10.48, df = 5 (P = 0.06); I² = 52%
Test for overall effect: Z = 6.08 (P < 0.00001)

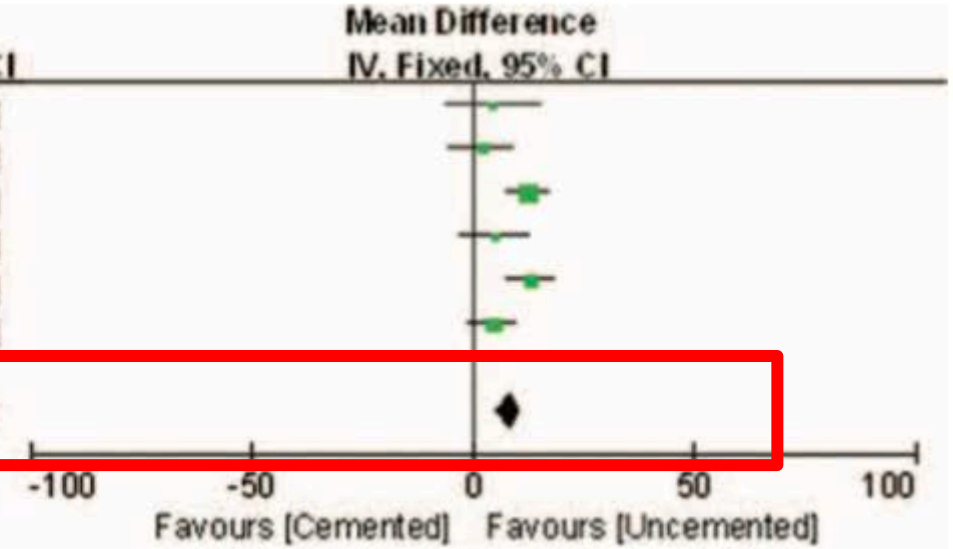
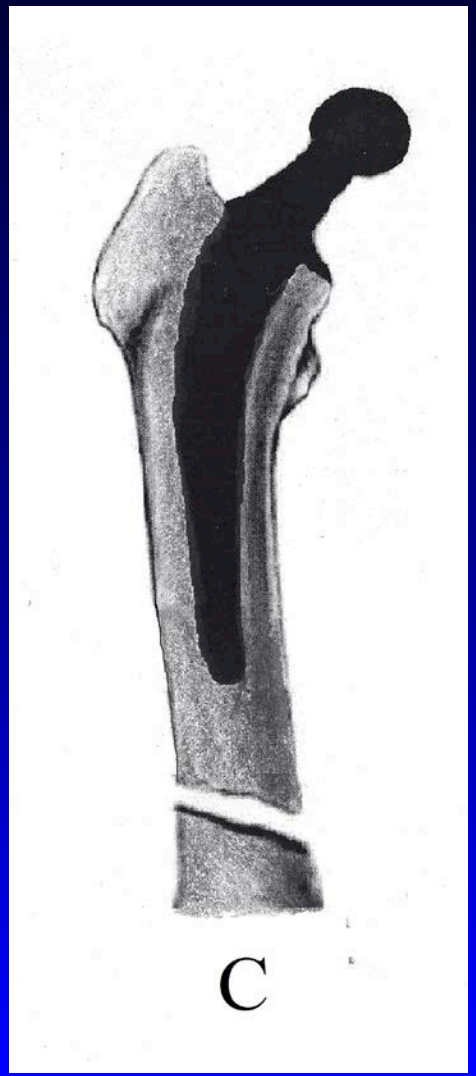


Figure 11. The graph shows a forest plot of relative risk with a confidence interval for operation time.

- Yes, 8 minutes

2. If the stem is stable, fix it!



Fix it well!

- 4.5 Compression plate
- Long, span the entire bone

- Distal fixation - Bicortical screws

- Proximal fixation:
    - Transcortical screws
    - Locking screws
    - Cerclage wires

- Cortical strut as needed




Case examples


TABLE
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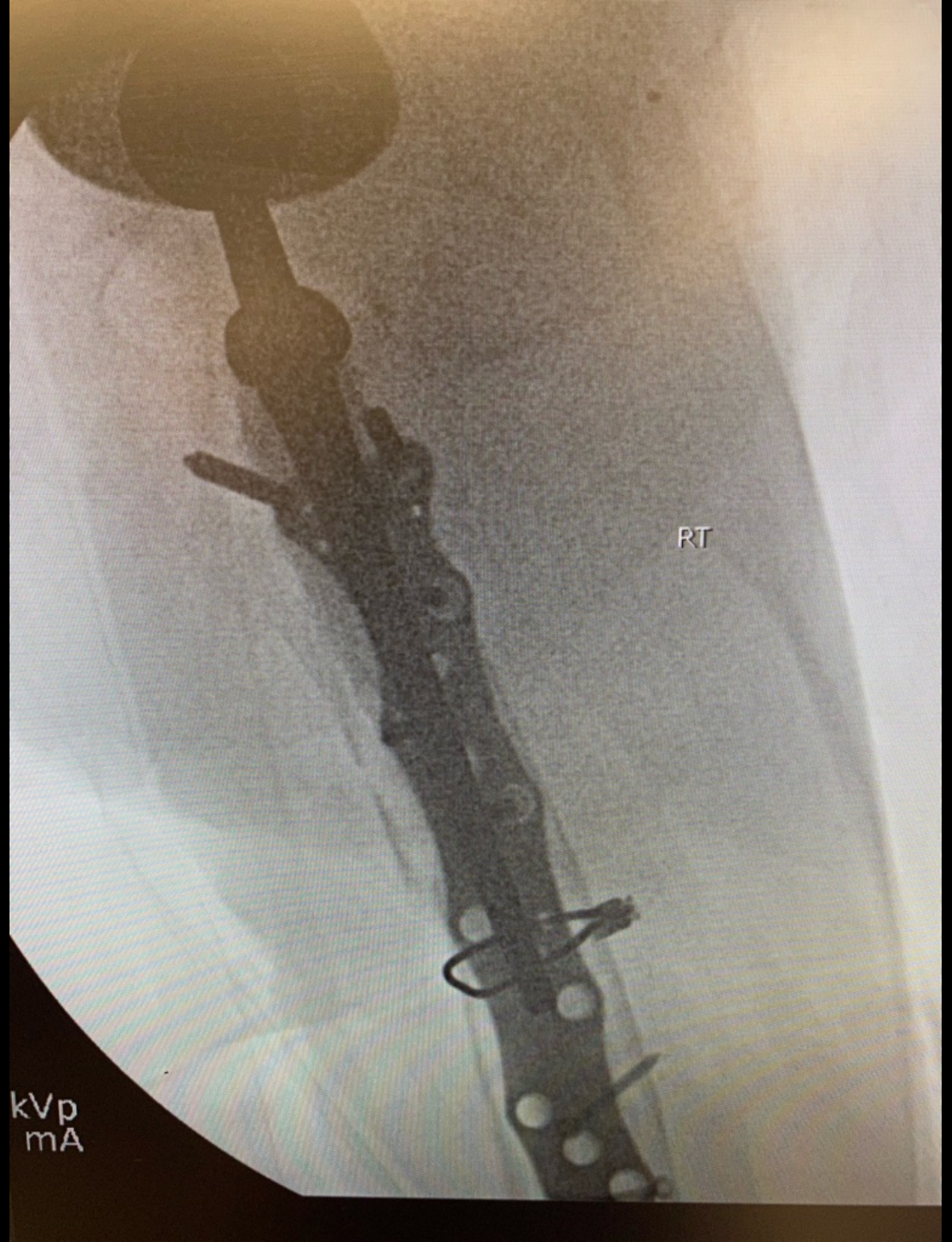
®


RT


RT


RT


RT
kVp
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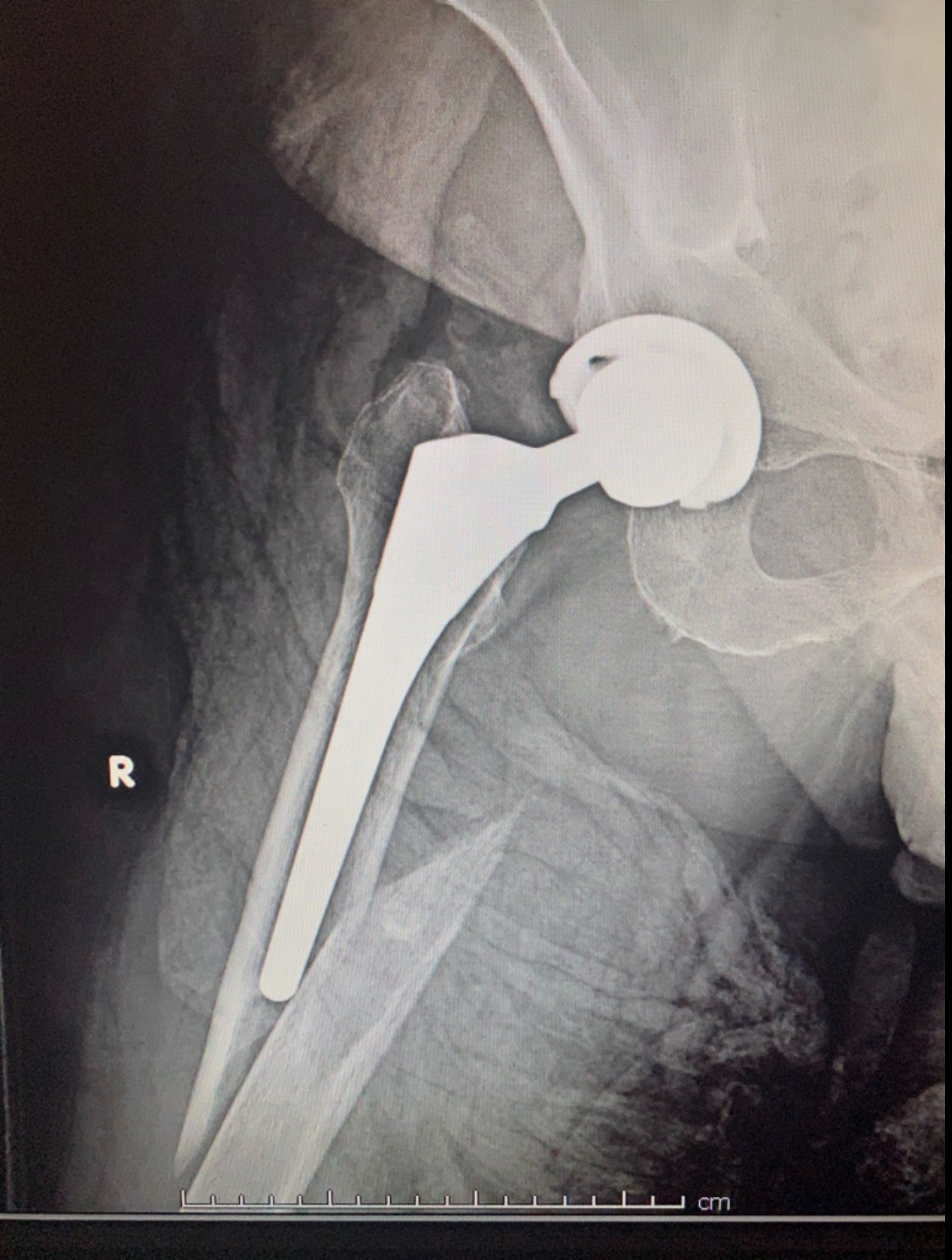
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OEC



OEC





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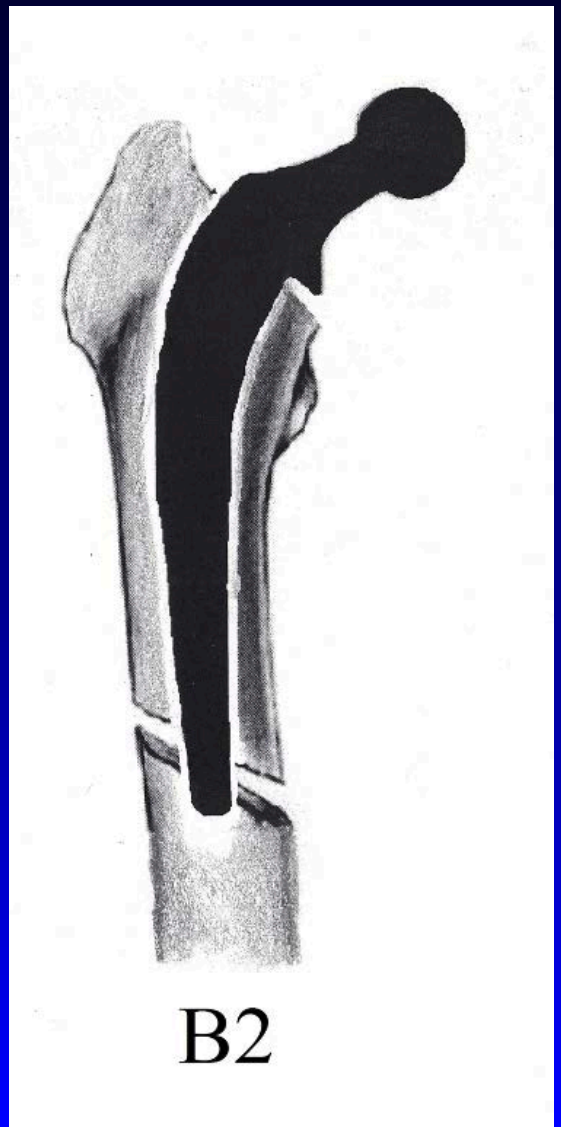
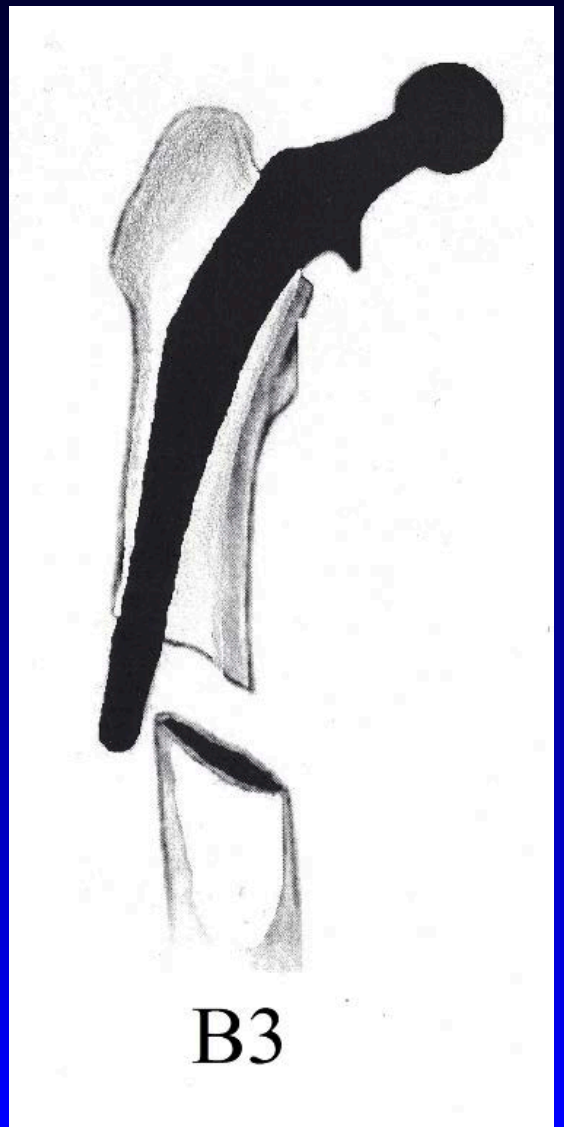
3. If the stem is loose, revise



B2



B3

3. If the stem is loose, revise

- In 20% you think the stem is stable, but it's loose
  - Higher chance of failure if unstable stem treated with ORIF

- How do you assess if stem is stable?
  - Some time's its obvious (sometimes not!)
  - Compare to prior x-rays
  - CT scan
  - Intra-op assessment

Revision to longer stem

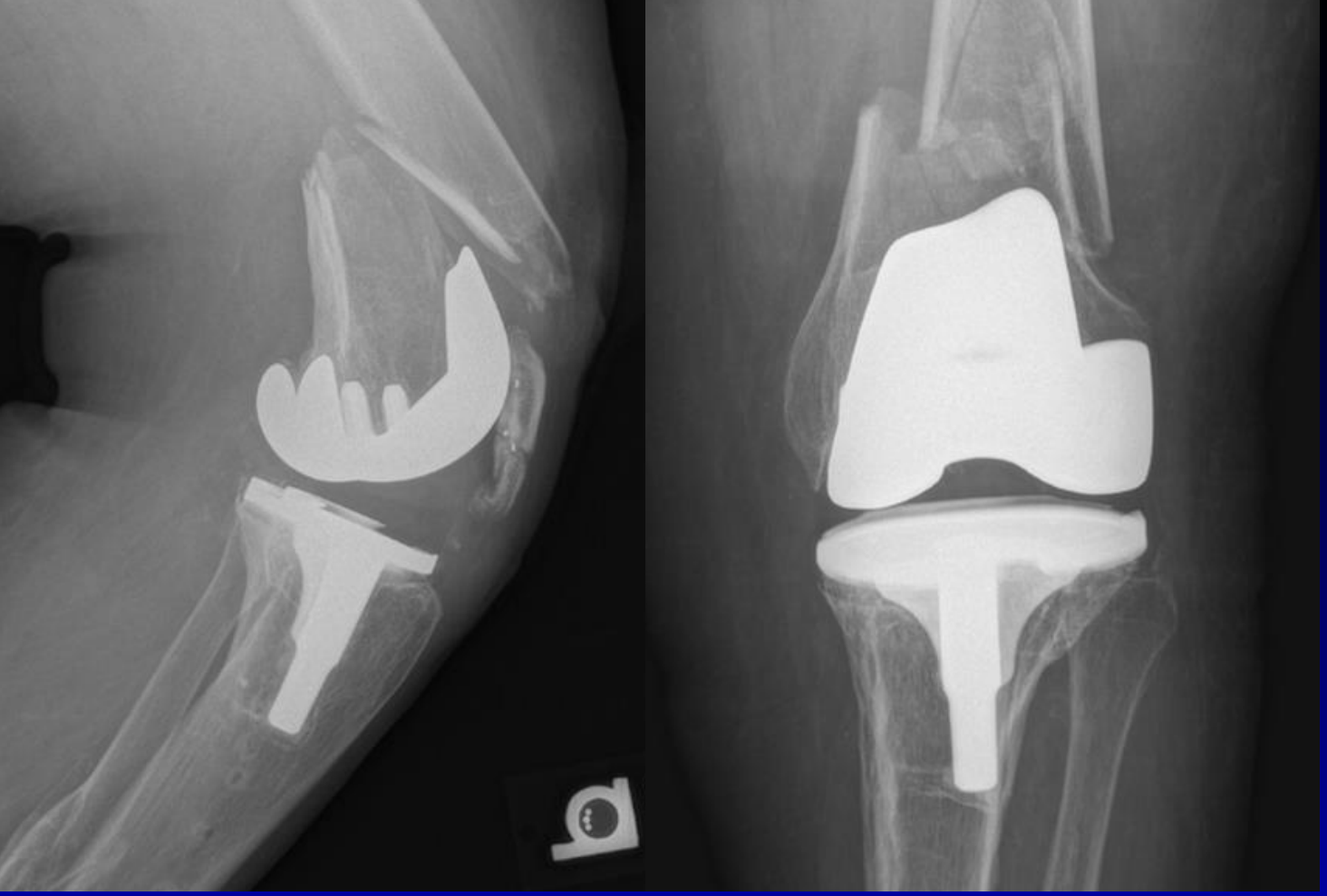
- Rule out infection
- Longer stem, go for distal fixation
- Fix the bone around the new stem (cerclage or plate)
- Use of cortical strut allograft as needed if poor bone quality (B3 fractures)

Journal of the Korean Fracture Society24(1):121


L
56/15
PORTABLE
SUPINE

What about Fractures around a TKA?

- Same principles
- Fix if stable
  - ORIF with plate
  - ORIF with nail
- Revise if
  - implant loose
  - Poor bone/very distal fracture



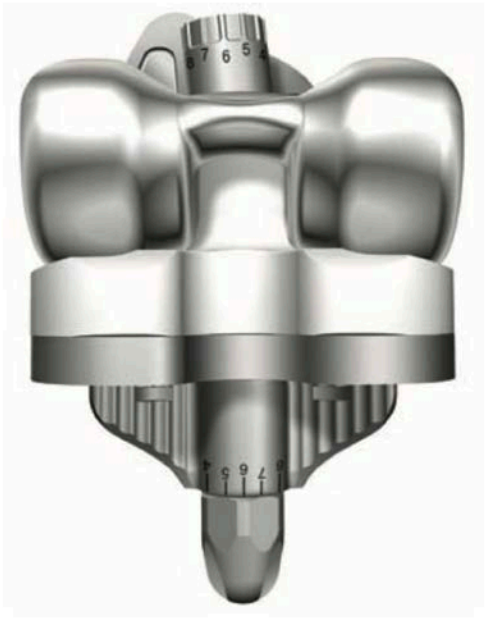
When can you use a nail?

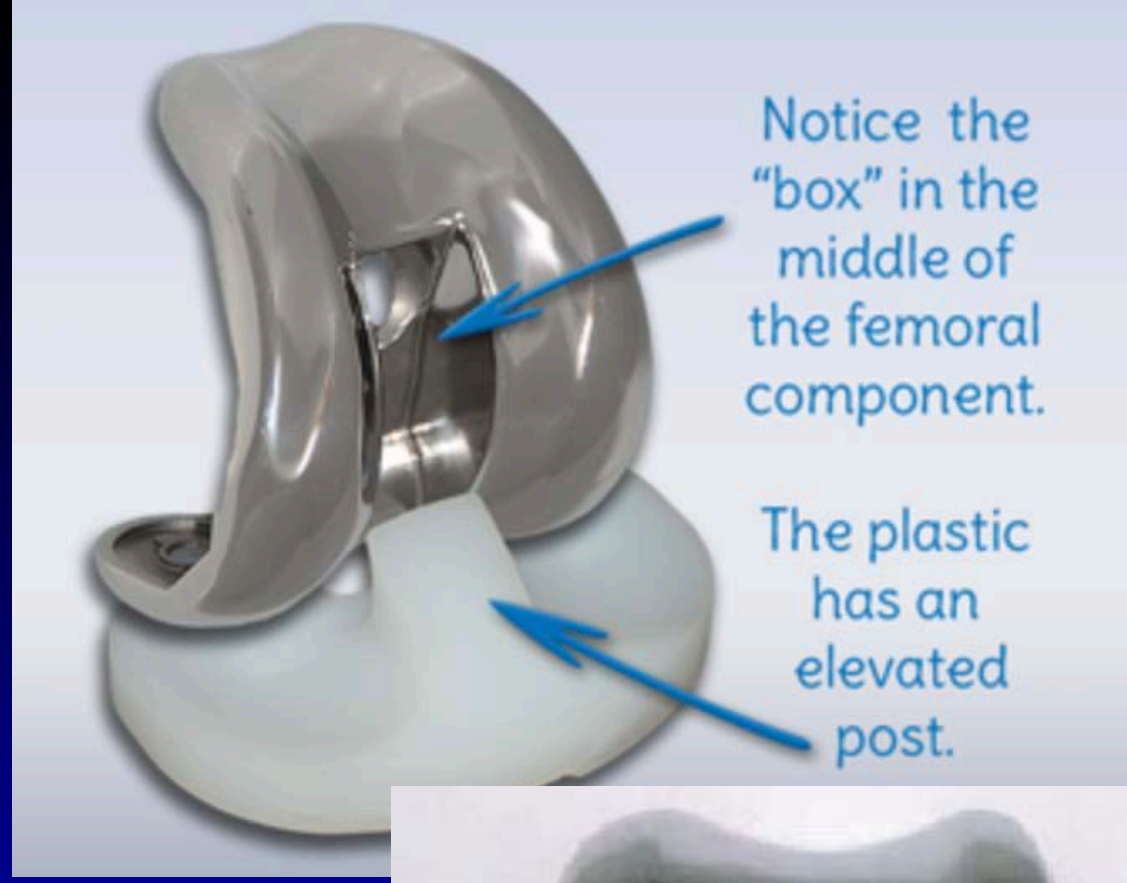
- Stable TKA implant
- No implant in the hip
- Fracture proximal enough to obtain distal locking screw fixation
  - Fracture at the level of anterior flange or proximal to it
  - Use a nail with biplanar screw fixation, lots of distal screw options
- Open box
  - Good AP/Lateral x-rays, CT
  - Know existing implants and measurement of TKA (can obtain OR notes)

Benefits of IMN?

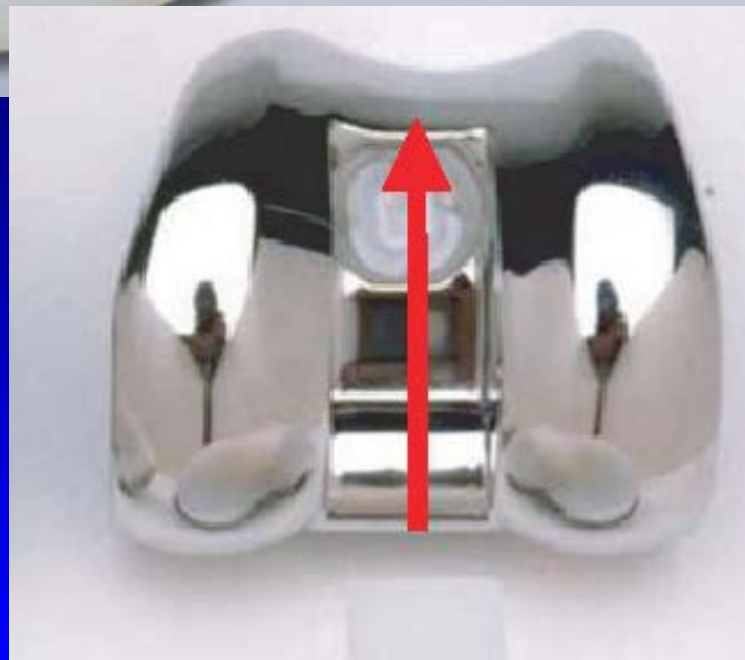
- Faster
- Smaller incisions
  - Specially for elderly with poor soft tissues
  - Diabetic
  - Obese
- Less wound complications and infection
- Earlier time to WB

Open box




Notice the "box" in the middle of the femoral component.
The plastic has an elevated post.

Closed box



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journal homepage: www.arthroplastyjournal.org

Periprosthetic Supracondylar Femoral Fractures Above a Total Knee Replacement: Compatibility Guide for Fixation With a Retrograde Intramedullary Nail

Simon M. Thompson, MBBS, BSc(Hons), MSc, MD(Res), FRCS(Tr&Orth), Edward A.O. Lindisfarne, MBBS, BA(Hons), MA, MRCS, Neil Bradley, FRCS(Orth), Matthew Solan, FRCS(Orth)

Royal Surrey County Hospital, Guildford, UK

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ABSTRACT

The incidence of total knee arthroplasty (TKA) is increasing, as are periprosthetic supracondylar femoral fractures. Treatment is complex and may involve the use of a retrograde intramedullary femoral nail, and it is essential to know the nail will fit through the femoral prosthesis in line with the intramedullary canal. Knowledge of certain measurements is crucial i.e. minimal intercondylar distance and the position of the notch on the femoral component in relation to the intramedullary canal. A review of TKA prostheses

Table
Compatibility Guide Showing TKR Manufacturer With Notch Distances.

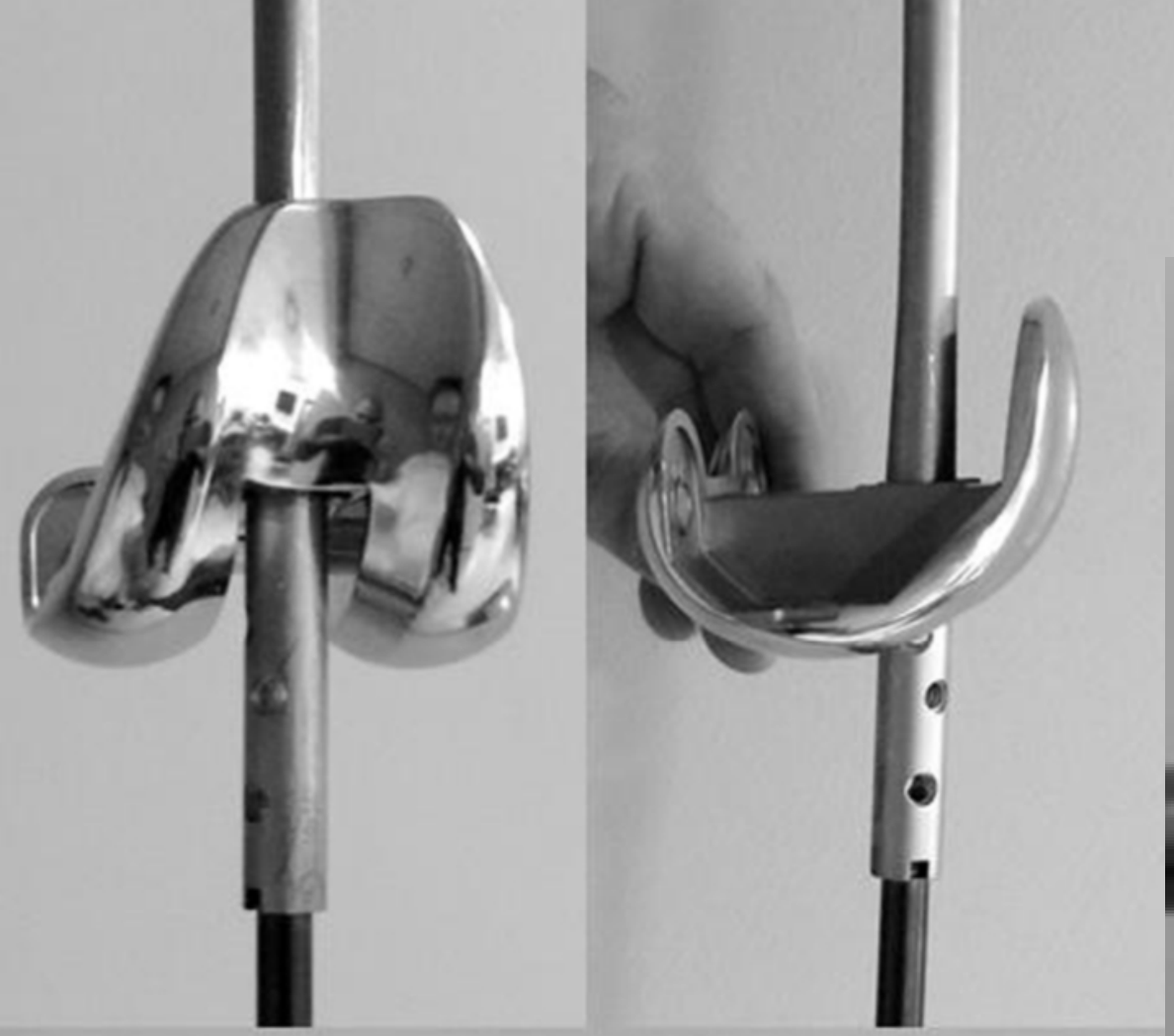
Manufacturer	Model	Size/Description	Minimal Intercondylar Distance (mm)	Compatible?	Notch Posterior?	Column1
Biomet	Vanguard CR and PS	Sizes 55–80	16.26-21.33	Yes	No	
	AGC CR and PS	Sizes 55–80	18.0	Yes	No	*
	Maxim CR and PS	Sizes 55–80	21.0	Yes	No	**
	Universal		18.0	Yes	No	***
	Vanguard SSK360/DA360 (rev)	Sizes 55–80	Stemmed	NO	No	
	DA2000 (rev)	Sizes 55–75	Stemmed	NO	No	
Depuy (J&J)	LCS Complete	FEM POR Small-Large	12.903-20.371	Yes	No	
	LCS Complete RPS	FEM CEM Small-Large RT	13.462-20.371	Yes	No	
	LCS CR	Small+ to Large+	15.7–21.9	Yes	No	*
	LCS PS		N/A	N/A	No	*
	AMK		20.000	Yes	No	***
	Coordinate		Closed Box	NO	No	**
	Townley Knee		17.0	N/A	No	**
	PFC Press-Fit Condylar		20	Yes	No	***
	Sigma CR	Sizes 1.5–6	17.399-17.526	Yes	No	
	Sigma CR 150	Sizes 1.5–6, and 4 N	17.399	Yes	No	
	Sigma CS, PS & Lugged	Sizes 1.5–6, and 4 N	11.557	Yes	No	
	Sigma TC3	Sizes 1.5–5	11.557	Yes	No	
	Sigma PS RPF hiflex		Closed Box	NO	No	
	Insall-Burstein PS		15.0	Yes	No	***
	Total Condylar 1		15.0	N/A	No	**
	Total Condylar 2		18.0	N/A	No	**
	Cyntor		25.0	N/A	No	**
DJO	Foundation	Sizes 2–12	17 - 19	Yes	No	
(Osteotec)	3DKnee	Sizes 2–12	14 - 17	Yes	No	
Exactec	Condylar		N/A	NO	No	**
	PS		N/A	NO	No	**

Retrograde femoral nailing of periprosthetic fractures around total knee replacements

Mark D. Jones [b,*], Charlotte Carpenter [a], Stephen R. Mitchell [a], Michael Whitehouse [c], Sanchit Mehendale [a]

Injury, Int. J. Care Injured 47 (2016) 460–464

Total knee replacement			Retrograde femoral nail																		
			Stryker					Smith & Nephew					Biomet					Depuy				
			T2 supracondylar femoral nail (10 mm)					Trigen retrograde femoral nail (10 mm)					Phoenix retrograde nail (10.5 mm)					ACE retrograde femoral nail (10 mm)				
Manufacturer	Model	Size	Technically feasible	Posterior entry	Scratches	Force required	Compatible	Technically feasible	Posterior entry	Scratches	Force required	Compatible	Technically feasible	Posterior entry	Scratches	Force required	Compatible	Technically feasible	Posterior entry	Scratches	Force required	Compatible
DePuy	PFC CR	3	Y	N	N	N	**Y**	Y	N	Y	Y	**N**	Y	N	Y	N	**N**	Y	N	Y	Y	**N**
		4	Y	N	N	N	**Y**	Y	N	Y	N	**N**	Y	N	N	N	**Y**	Y	N	N	N	**Y**
		6	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**
	PFC CS	5	Y	N	N	N	**Y**	N	NA	NA	NA	**N**	N	NA	NA	NA	**N**	N	NA	NA	NA	**N**
	LCS Complete CR	Standard	Y	N	N	N	**Y**	Y	N	Y	N	**N**	Y	N	Y	N	**N**	Y	N	Y	N	**N**
	ATTUNE CR	3	Y	Y	N	N	**N**	Y	Y	Y	N	**N**	Y	Y	Y	N	**N**	Y	Y	N	N	**N**
		5	Y	Y	N	N	**N**	Y	Y	N	N	**N**	Y	Y	Y	N	**N**	Y	Y	N	N	**N**
	ATTUNE PS	5	Y	N	N	N	**Y**	Y	N	Y	N	**N**	Y	N	N	N	**Y**	Y	N	Y	N	**N**
Stryker	Scorpio CR	7	Y	N	N	Y	**N**	Y	N	N	Y	**N**	Y	N	N	Y	**N**	Y	N	Y	N	**N**
		9	Y	N	Y	N	**N**	Y	N	Y	N	**N**	Y	N	N	Y	**N**	Y	N	Y	N	**N**
	Triathlon CR	4	Y	N	N	N	**Y**	Y	N	Y	N	**N**	Y	N	Y	N	**N**	Y	N	Y	N	**N**
		5	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	Y	N	**N**	Y	N	Y	N	**N**
Biomet	Vanguard CR	65 mm	Y	N	Y	N	**N**	Y	N	N	Y	**N**	Y	N	N	Y	**N**	Y	N	Y	N	**N**
	AGC CR	55 mm	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**
		70 mm	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**
	AGC PR	60 mm	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**
		75 mm	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**
Smith & Nephew	Genesis II CR	3	Y	Y	Y	Y	**N**	Y	Y	Y	Y	**N**	Y	Y	Y	Y	**N**	Y	Y	Y	Y	**N**
		5	Y	Y	Y	Y	**N**	Y	Y	Y	Y	**N**	Y	Y	Y	Y	**N**	Y	Y	Y	Y	**N**
		8	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**	Y	N	N	N	**Y**

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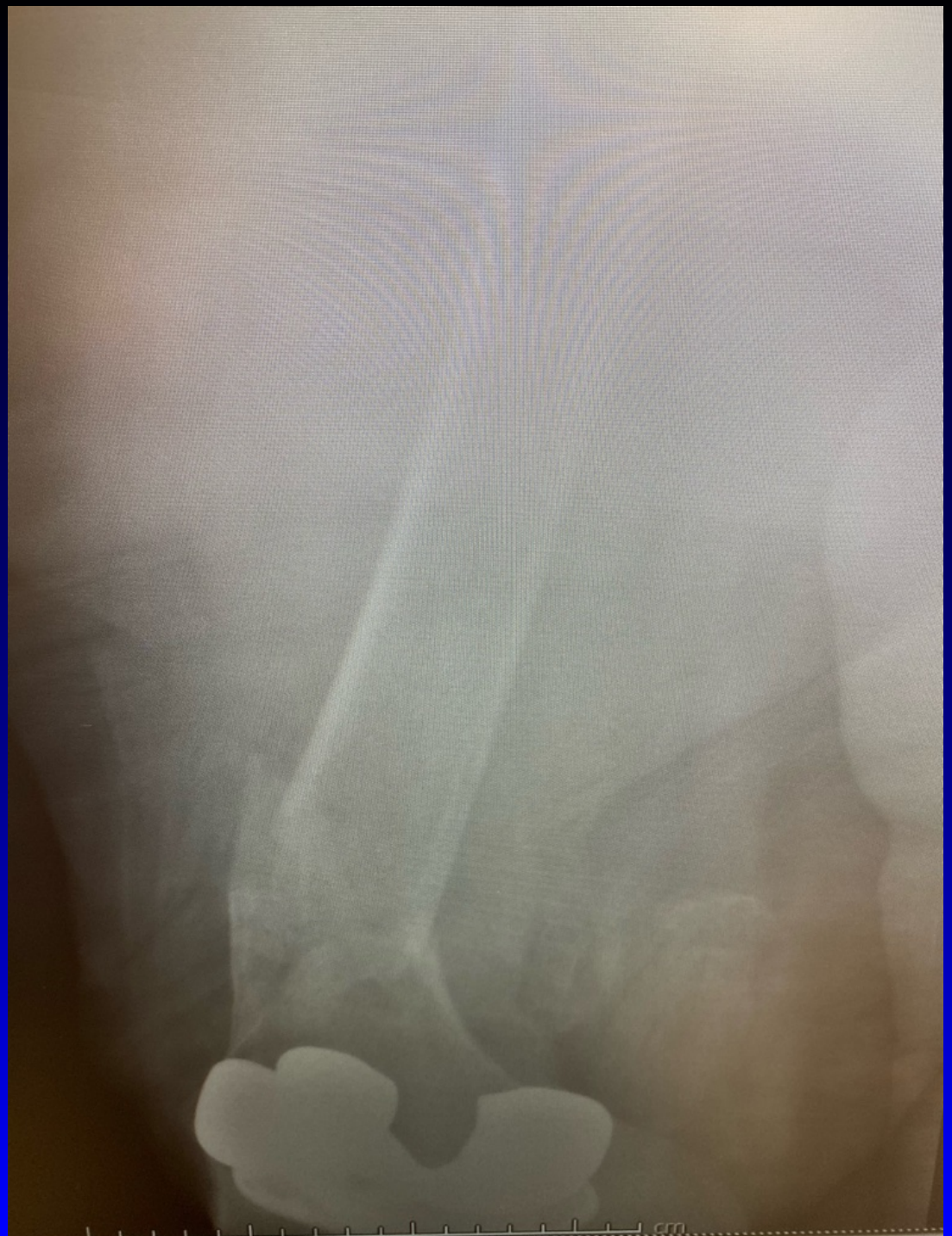
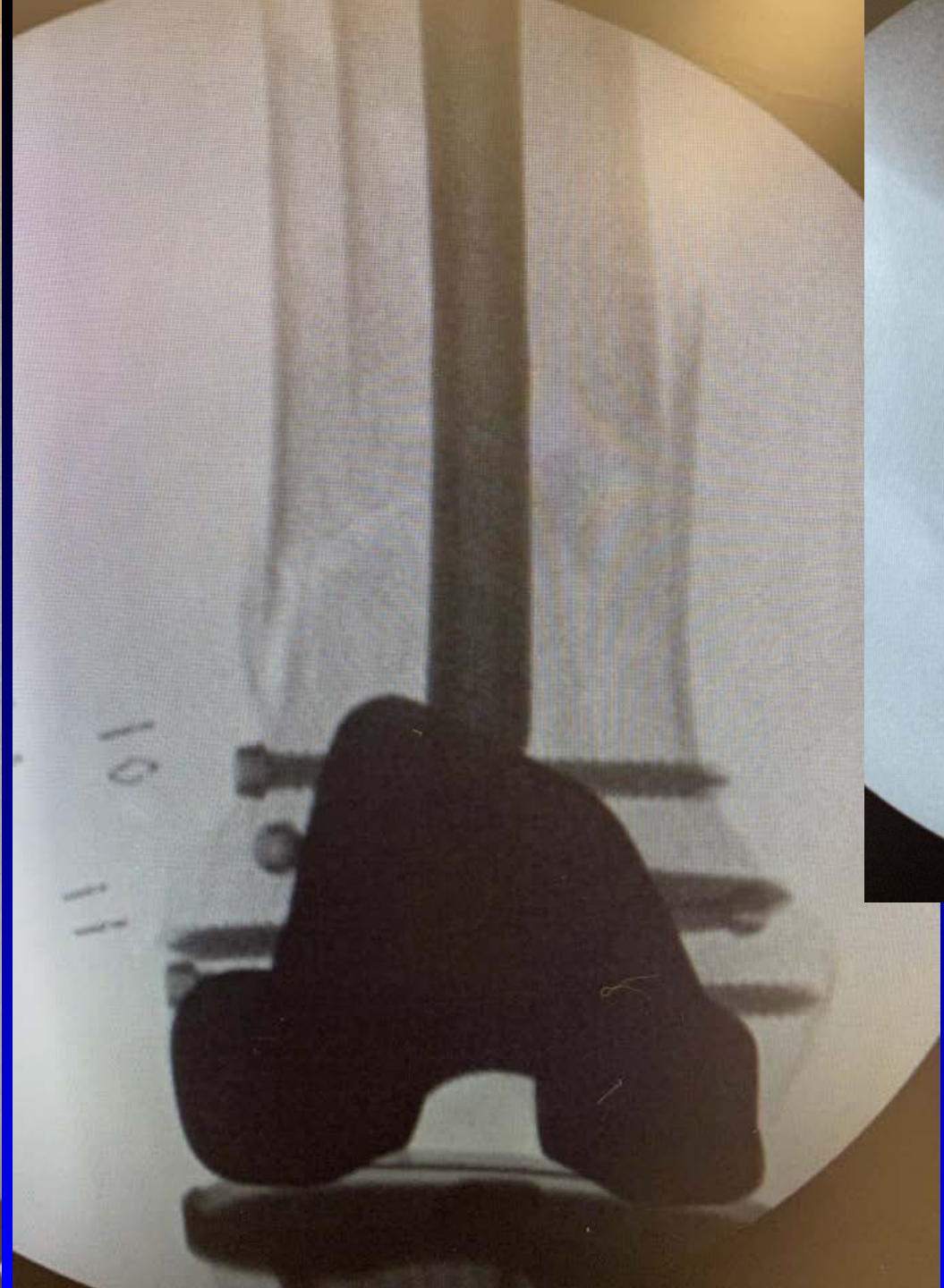



OEC


kVp
mA



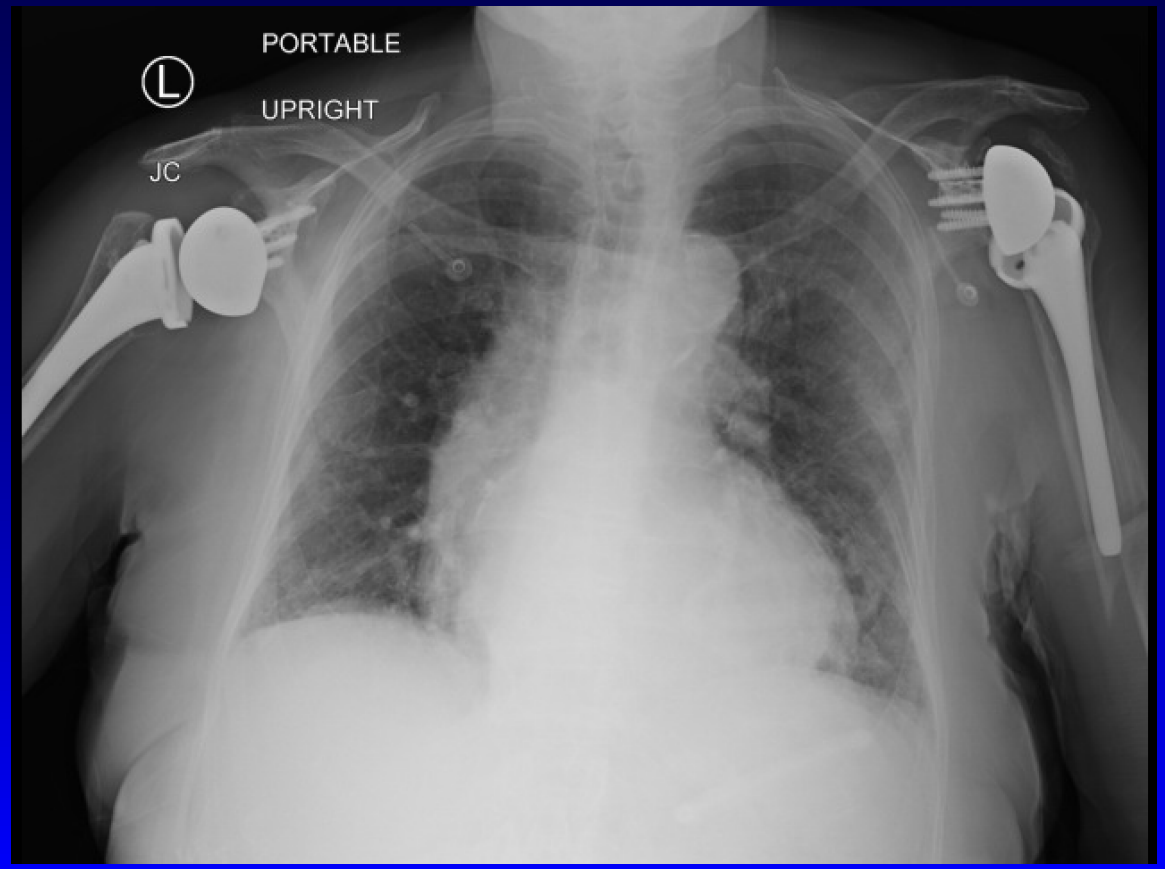

kVp
mA


OEC

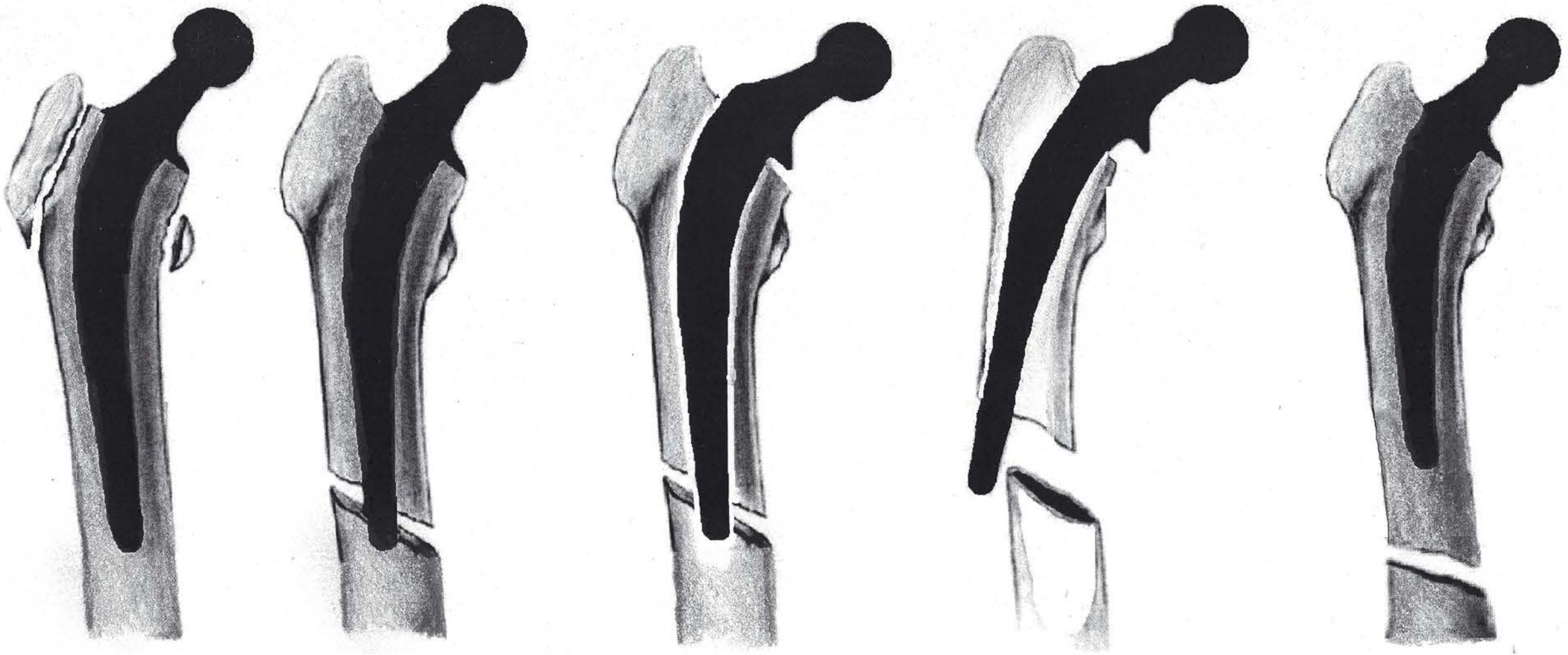
In summary

- IF the box is open, nail the distal femur!
  - Easy to do
  - Less OR time
  - Less infection
  - Smaller incisions
  - Earlier WB

Periprosthetic Fractures After Shoulder Arthroplasty

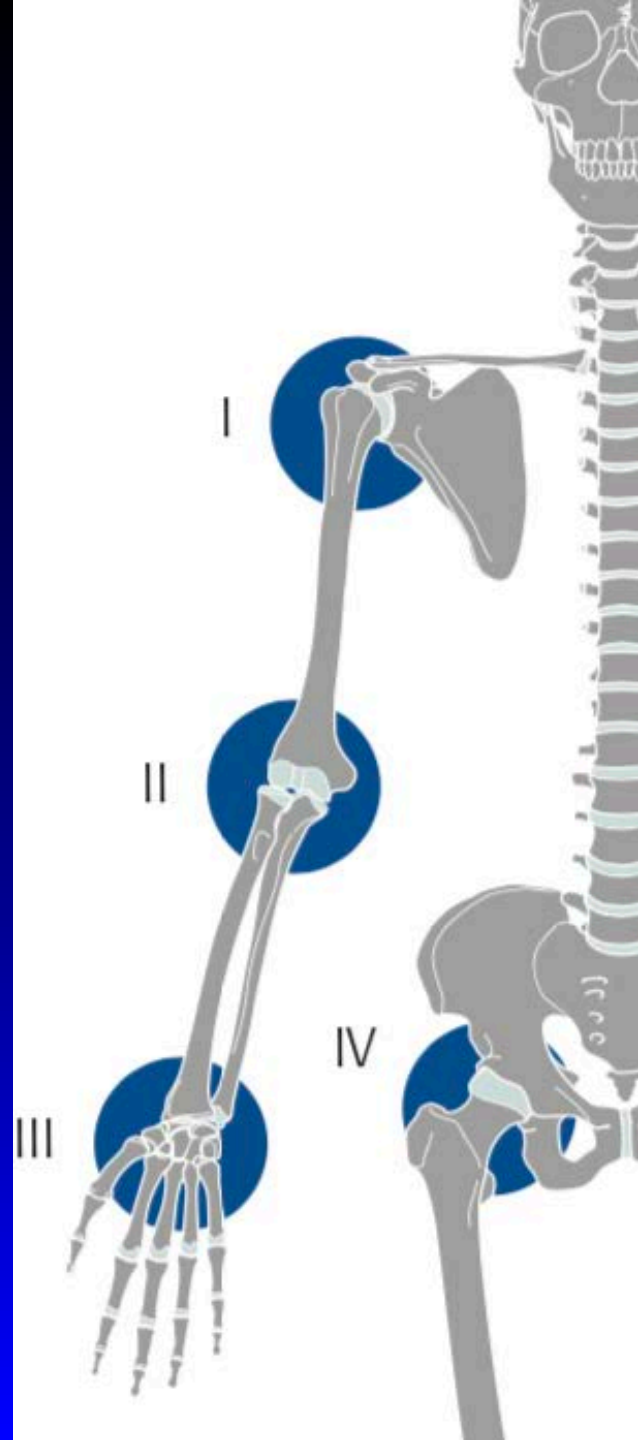


Vancouver Classification



Unified Classification System for Periprosthetic Fractures (UCPF)

- Type A – Apophysis fracture, no effect on implant stability
  - eg Tuberosities of the humerus --> Non-op
- Type B - Around the implant
  - B1: Implant stable, good bone --> ORIF
  - B2: Implant loose, good bone --> Revise
  - B3: Implant loose, poor bone or defect --> Revise + BG
- Type C - Clear of the implant --> Treat as usual
- Type D - interprosthetic, between two implants



J Orthop Trauma • Volume 32, Number 1 Supplement, January 2018

1. If the stem is stable, fix it!

2. If the stem is loose, revise it!

What's the issue with periprosthetic fractures?

- They are hard to fix
  - Minimal proximal bone quality proximally
  - Poor bone quality overall
  - Fixation failure is an issue

- Revision
  - needs longer components for distal fixation
  - May have to revise the glenosphere
  - Can have instability/impingement

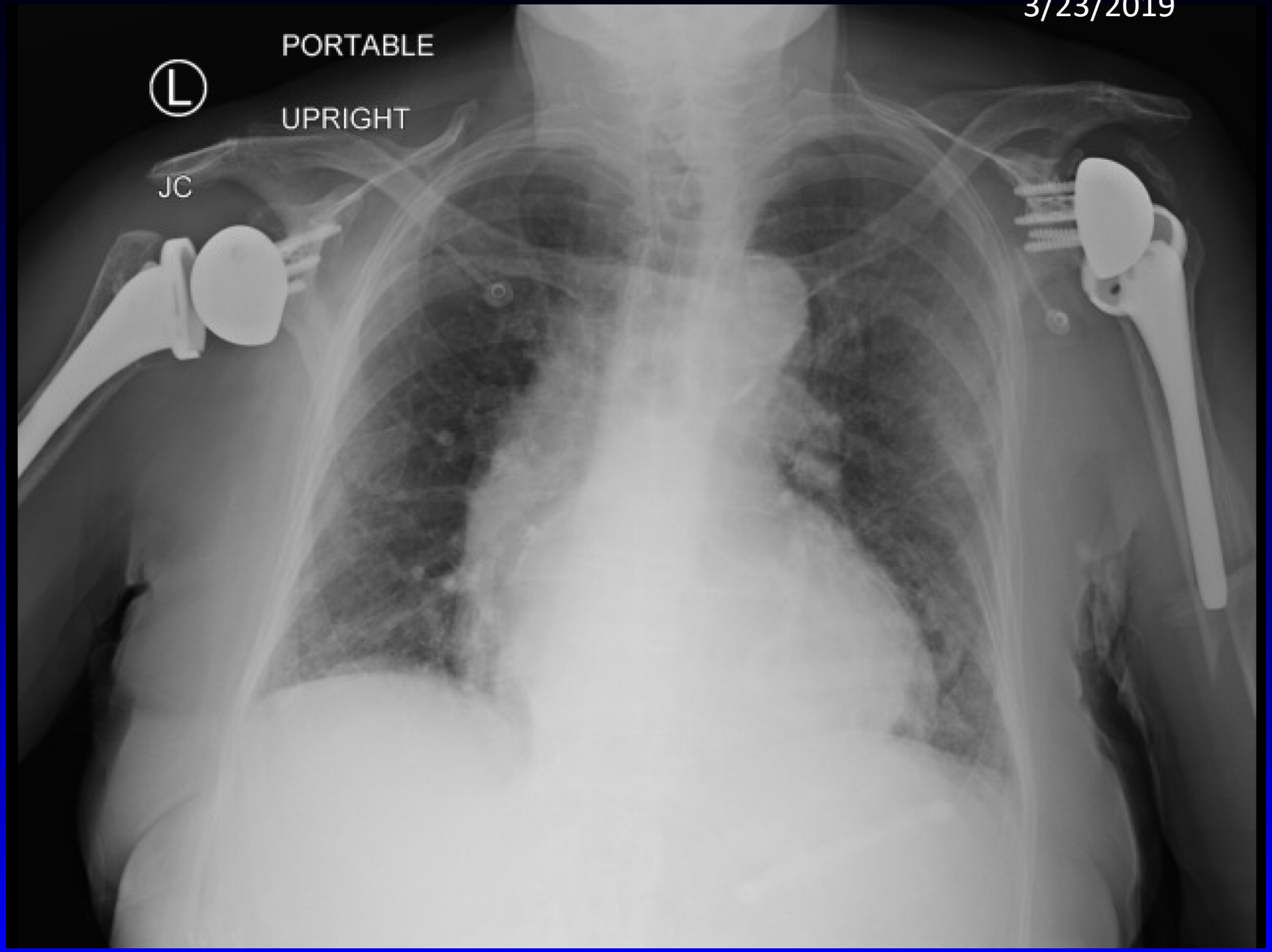
4 weeks post-op

Fix it well!

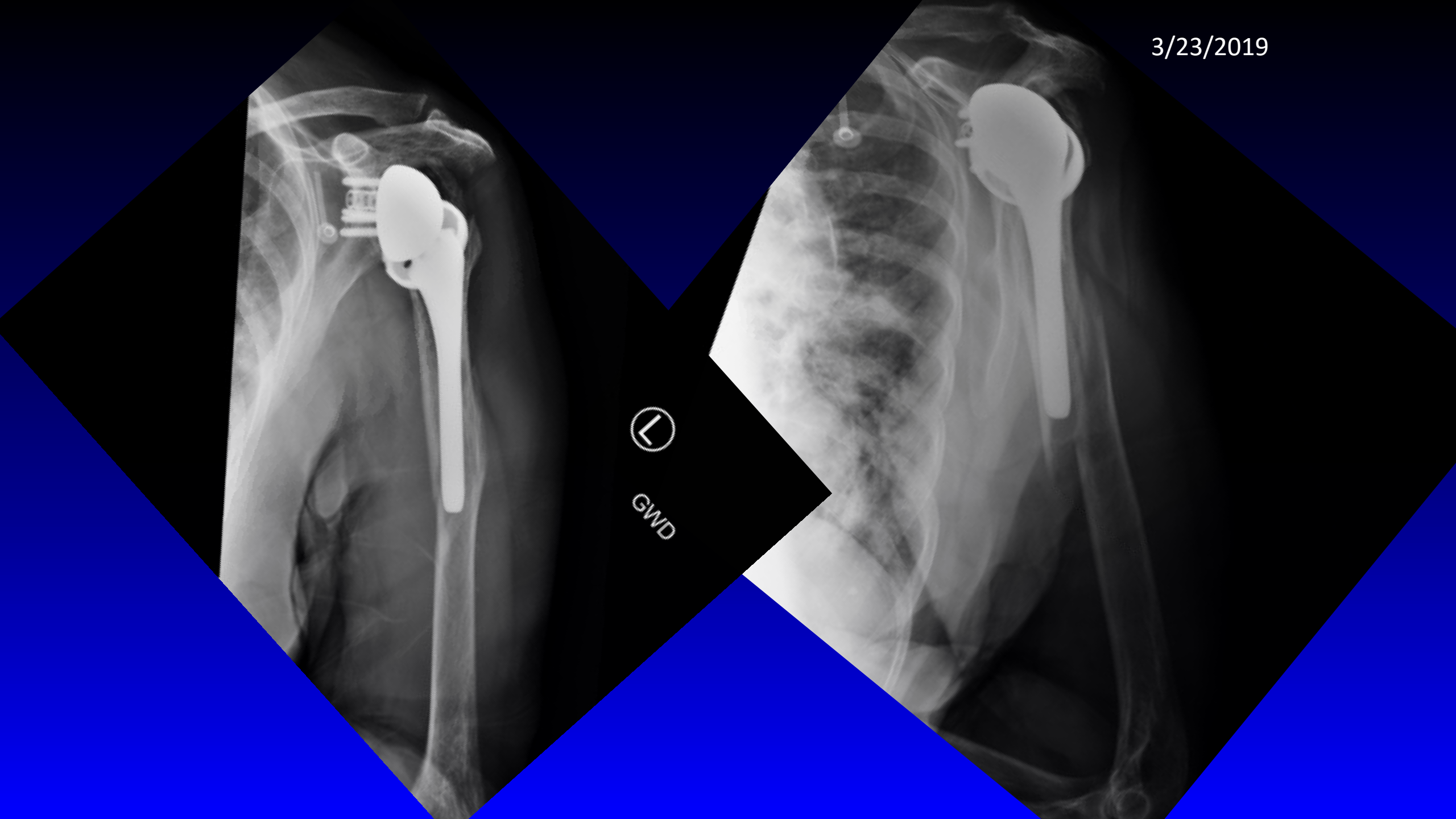
- 4.5 Compression plate, long, span the bone
- Distal fixation - Non locking screws
- Proximal fixation:
    - Transcortical non locking screws
    - Locking screws
    - Cerclage wires
- Cortical strut as needed

Case

- 90 F
- Left rTSA
- Ground level fall
- Mild dementia


3/23/2019
PORTABLE
L
UPRIGHT
JC

3/23/2019



3/31/2019

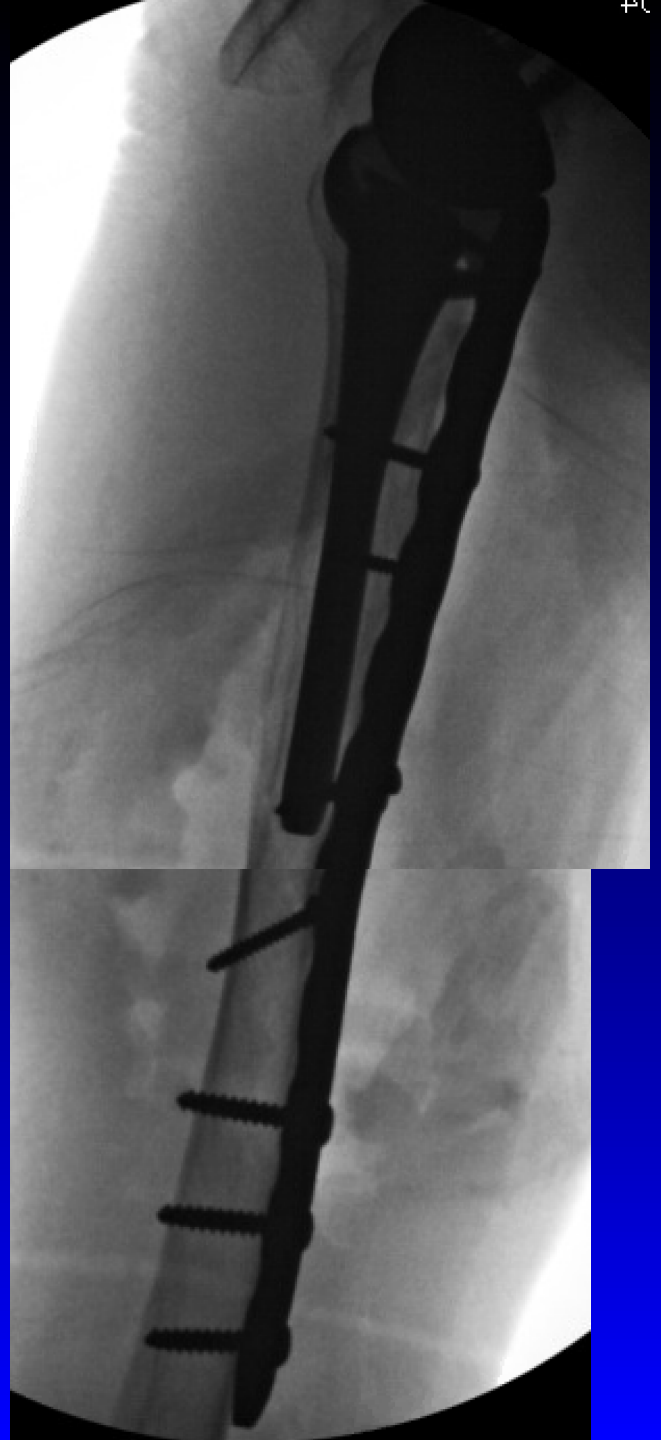
1 week later

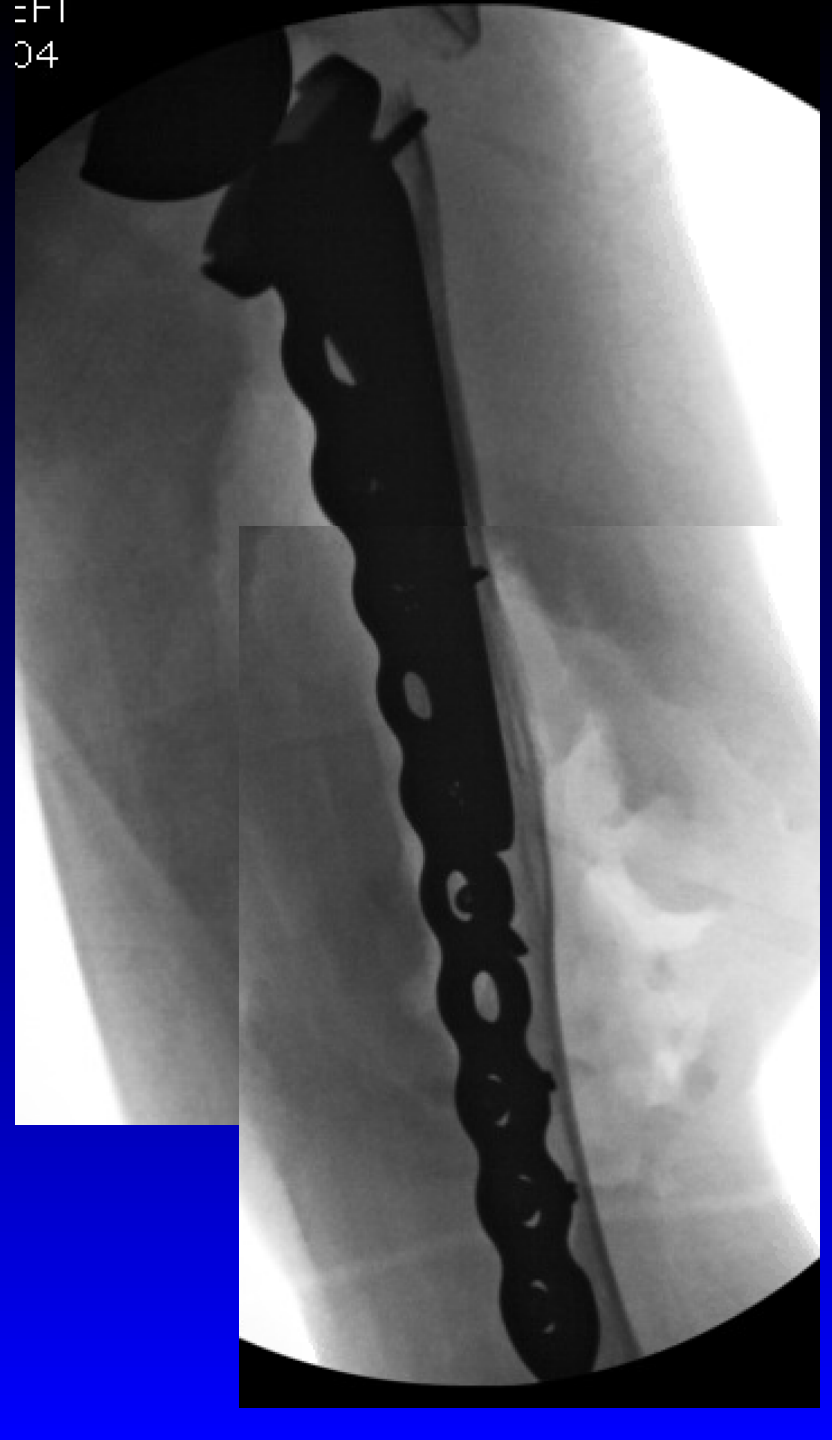
Now what?

Type B1

- Fracture location?
  - Tip of implant --> lots of stress
- Implant stability?
  - Stable --> Keep in place
- Bone quality/quantity?
  - Good

4/1/2019



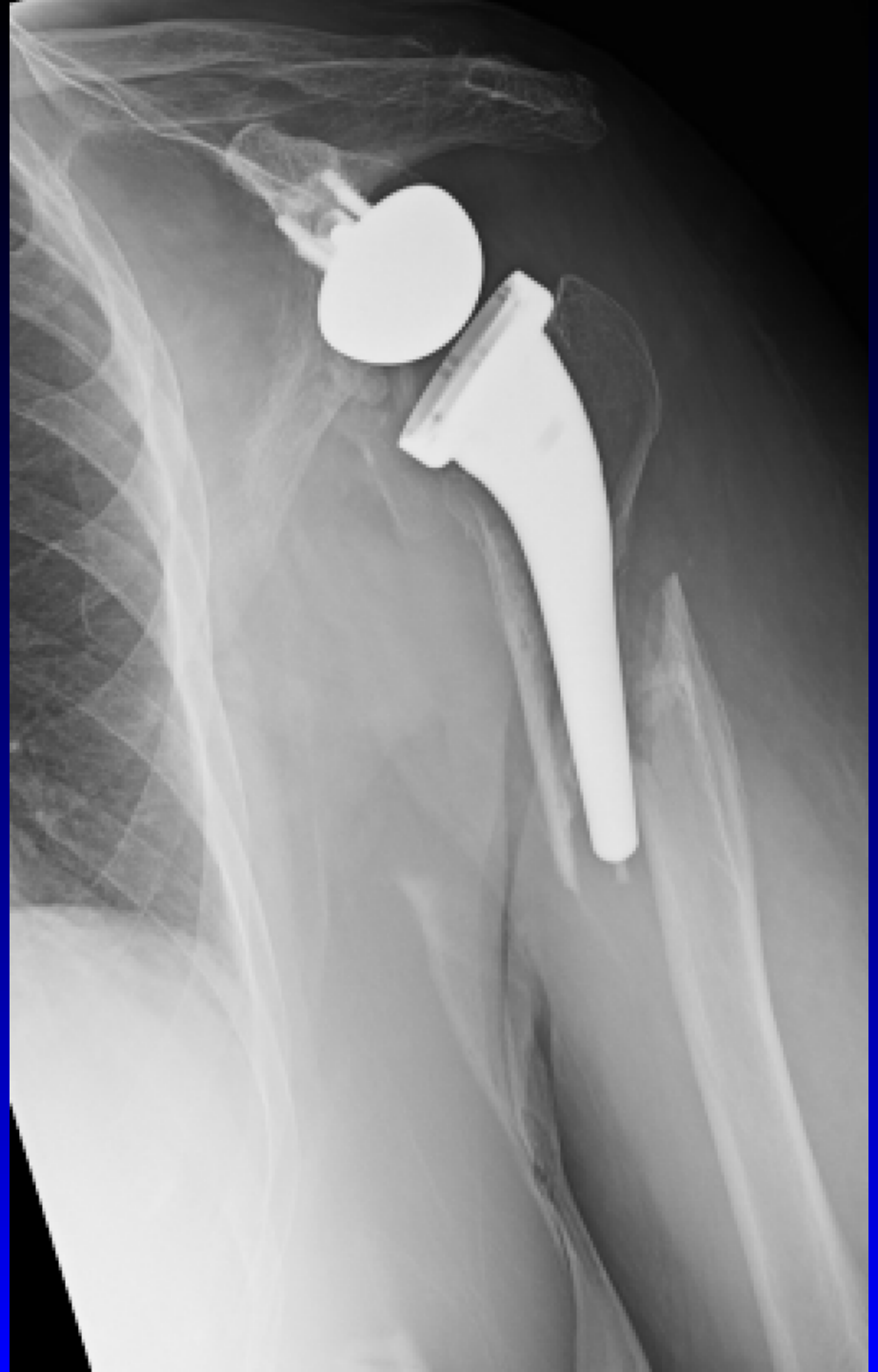


5/30/2019

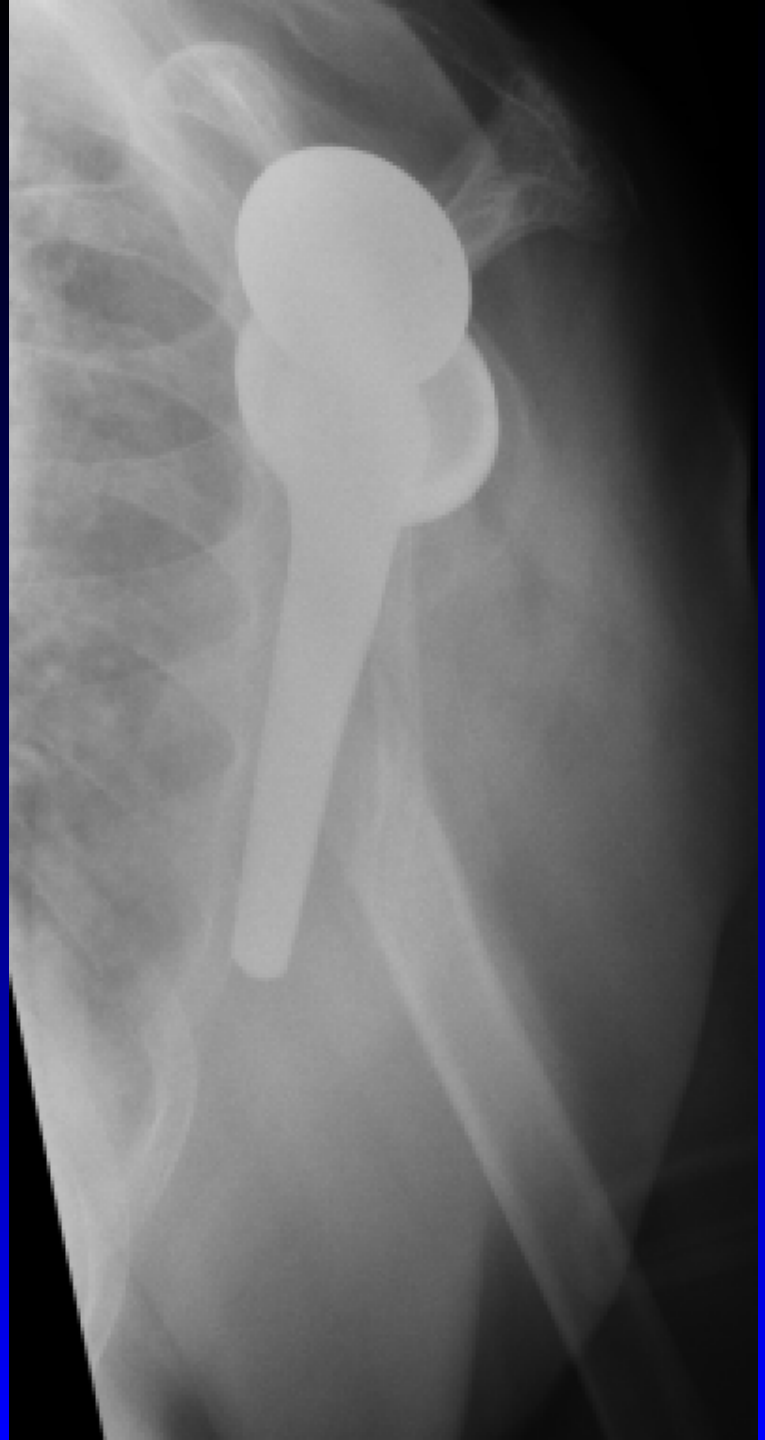
2 months post-op

Case

- 80 F
- Ground level fall
- Bilateral rTSA
- 6 years post rTSA for fracture

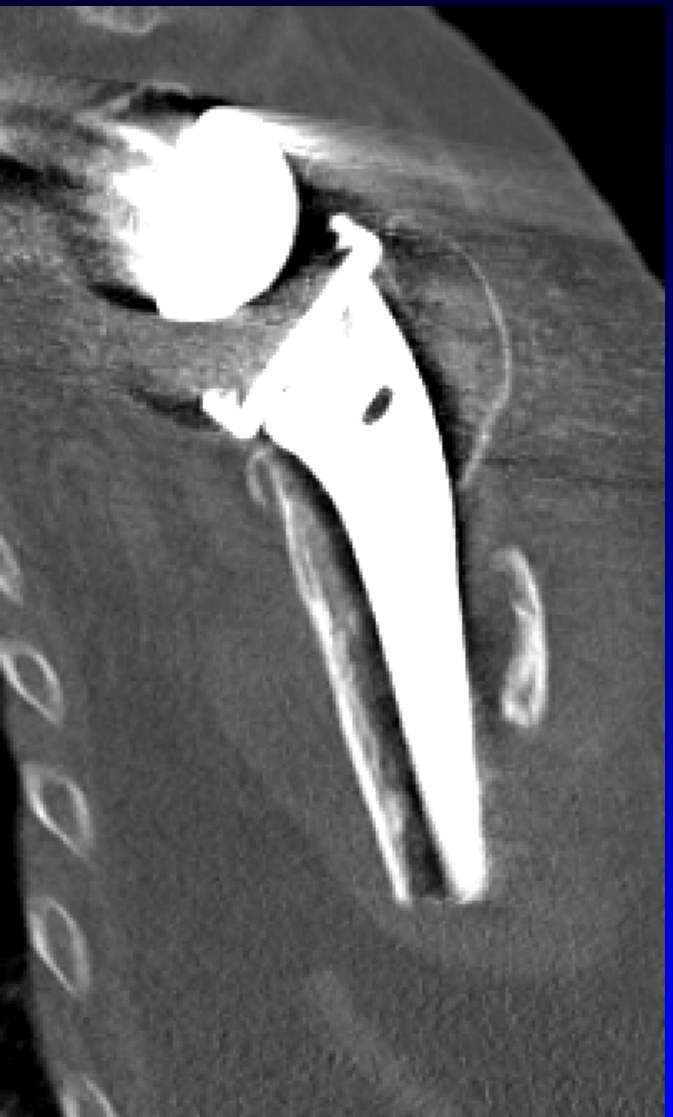
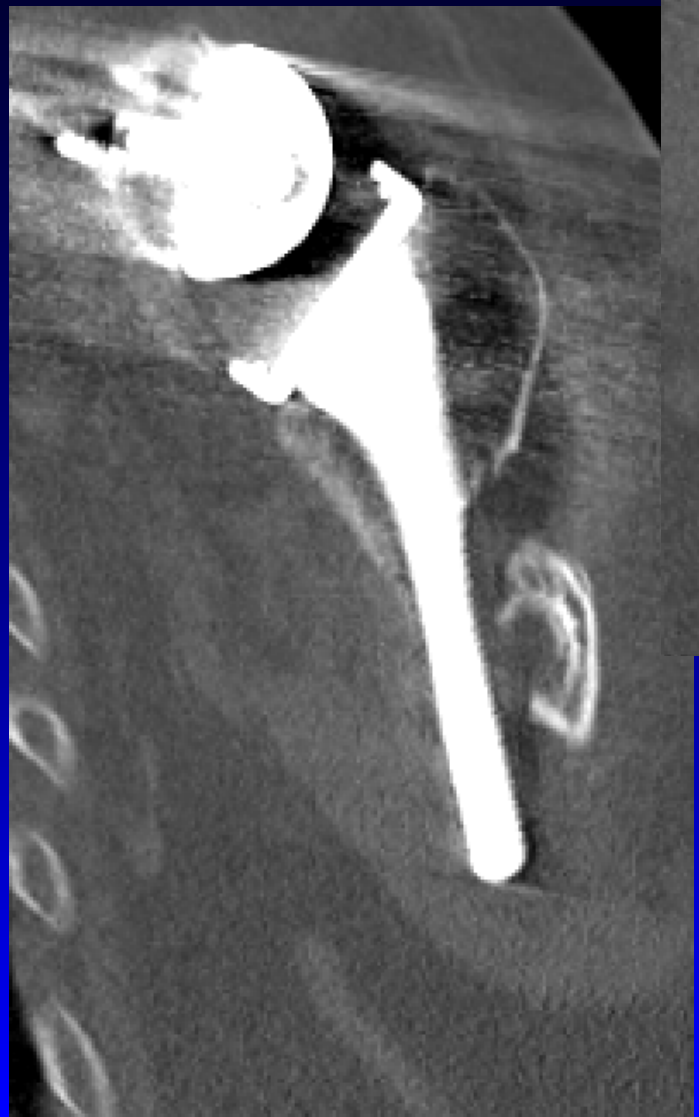


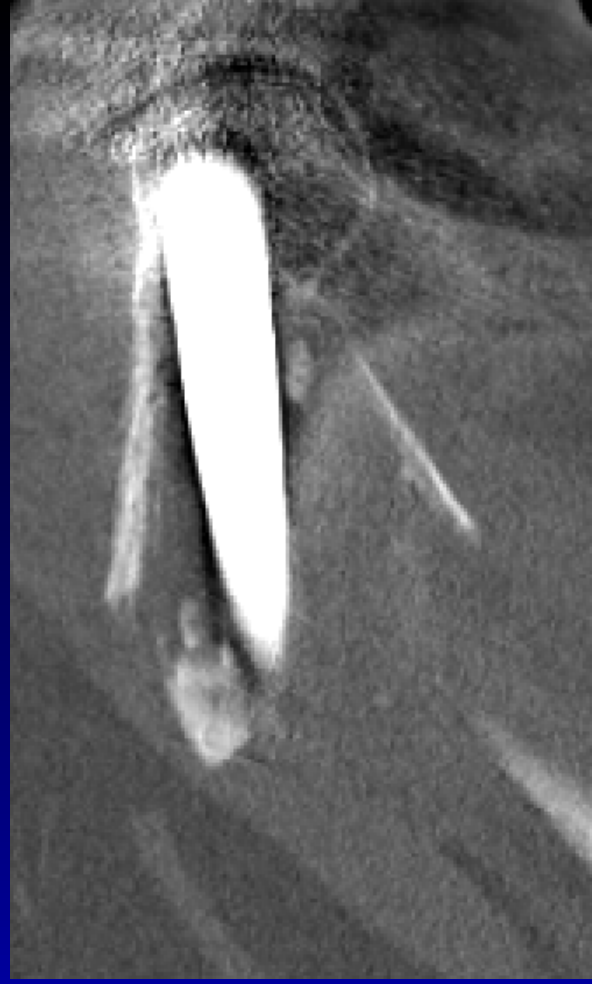
4/25/2021



5/31/2021

5 weeks later

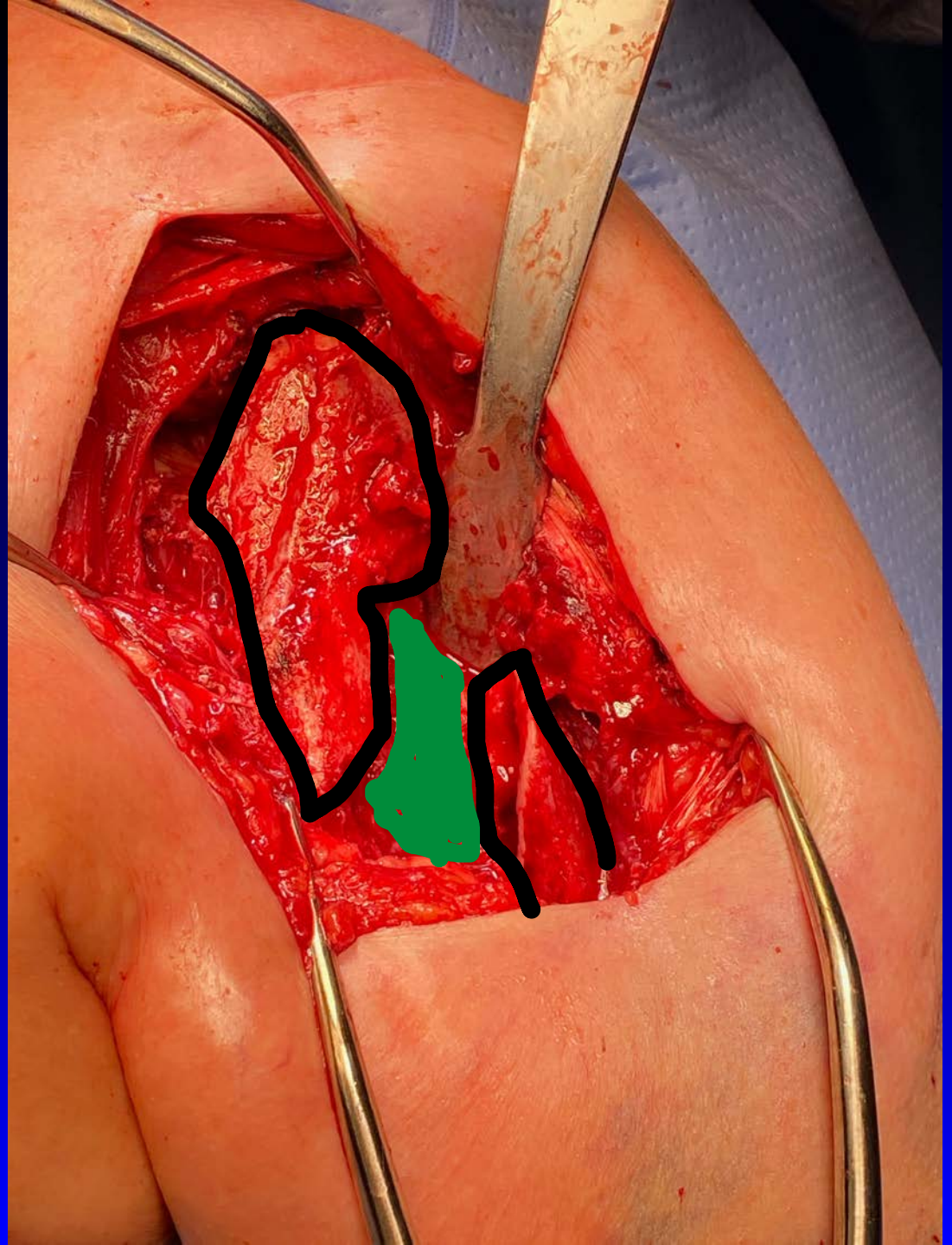



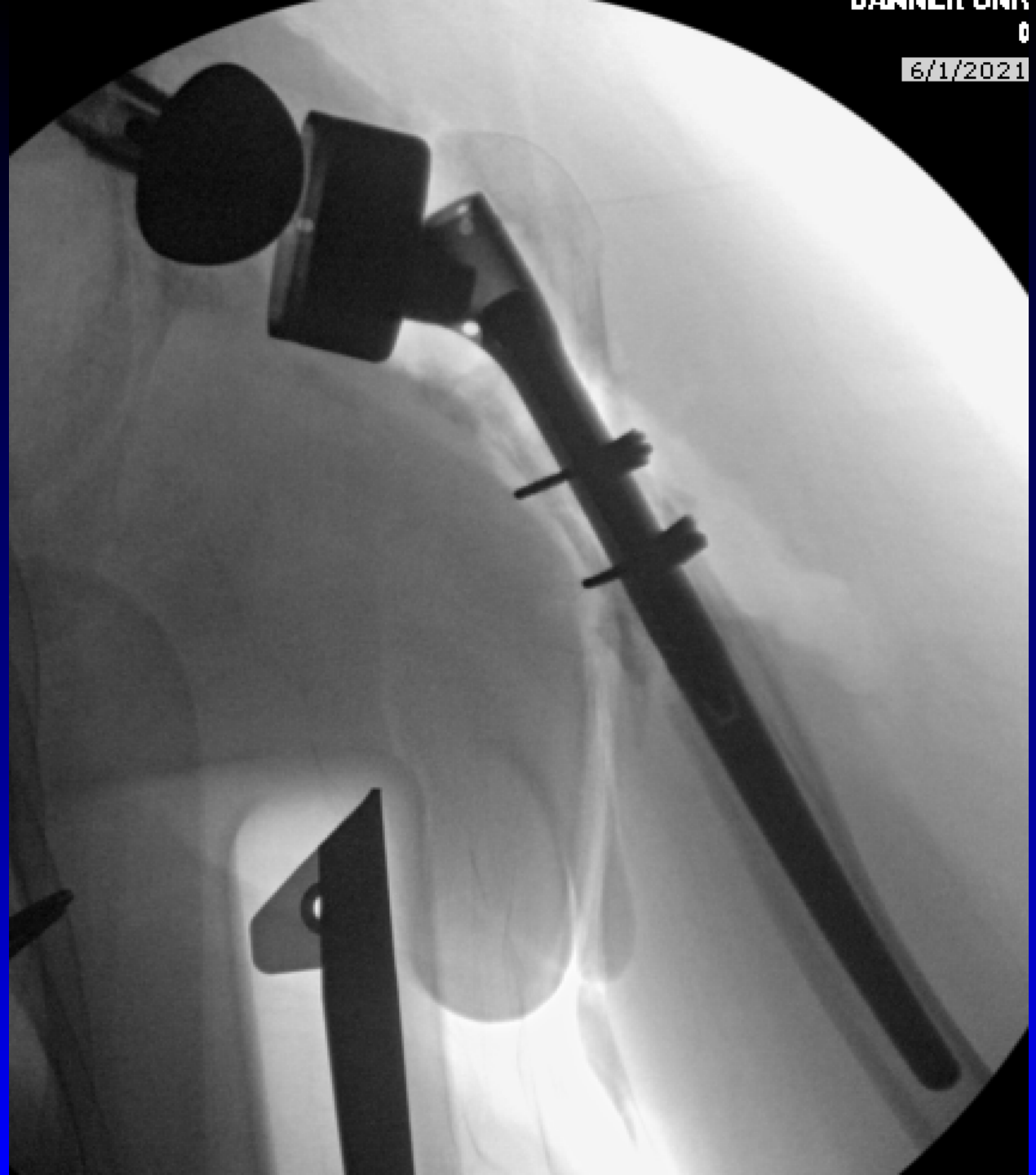


Now what?

Type B2

- Fracture location?
  - Tip of implant --> lots of stress
- Implant stability?
  - Unstable --> revise
- Bone quality?
  - Good bone for distal fixation

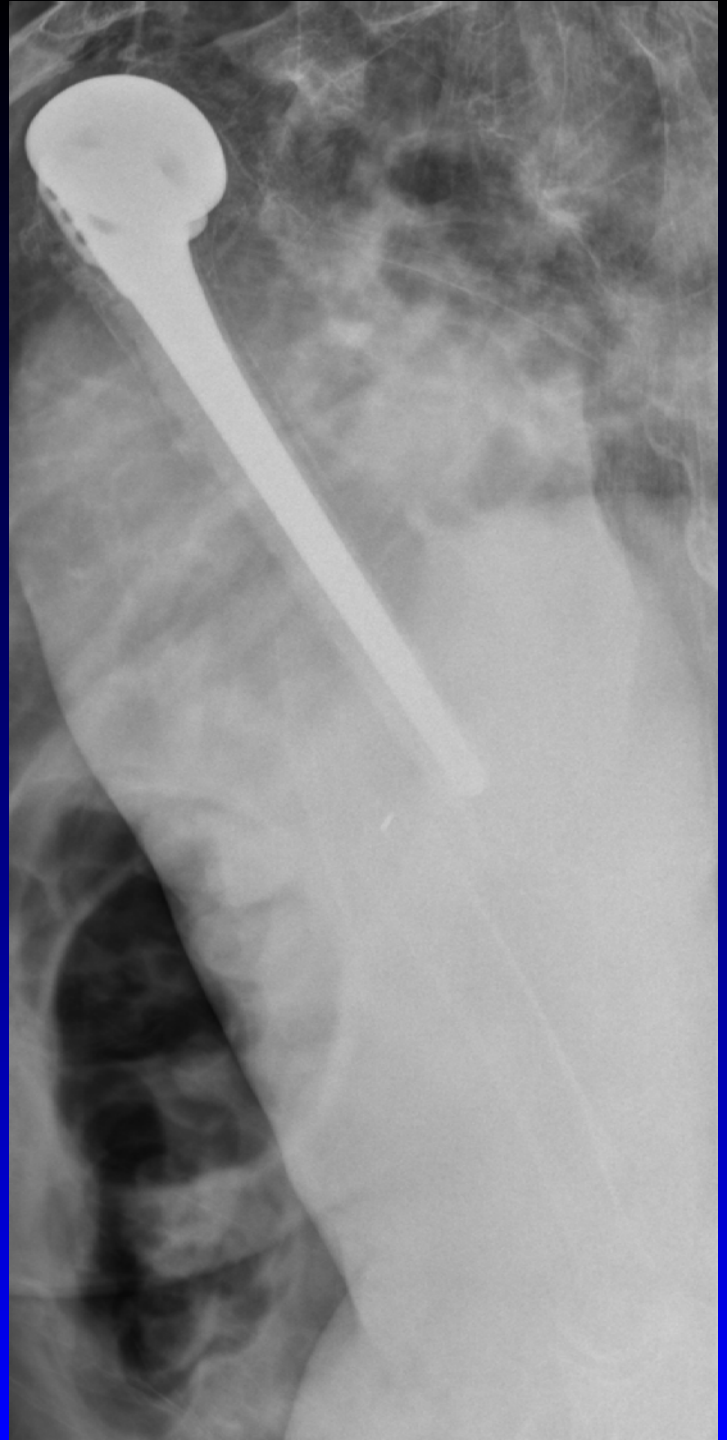


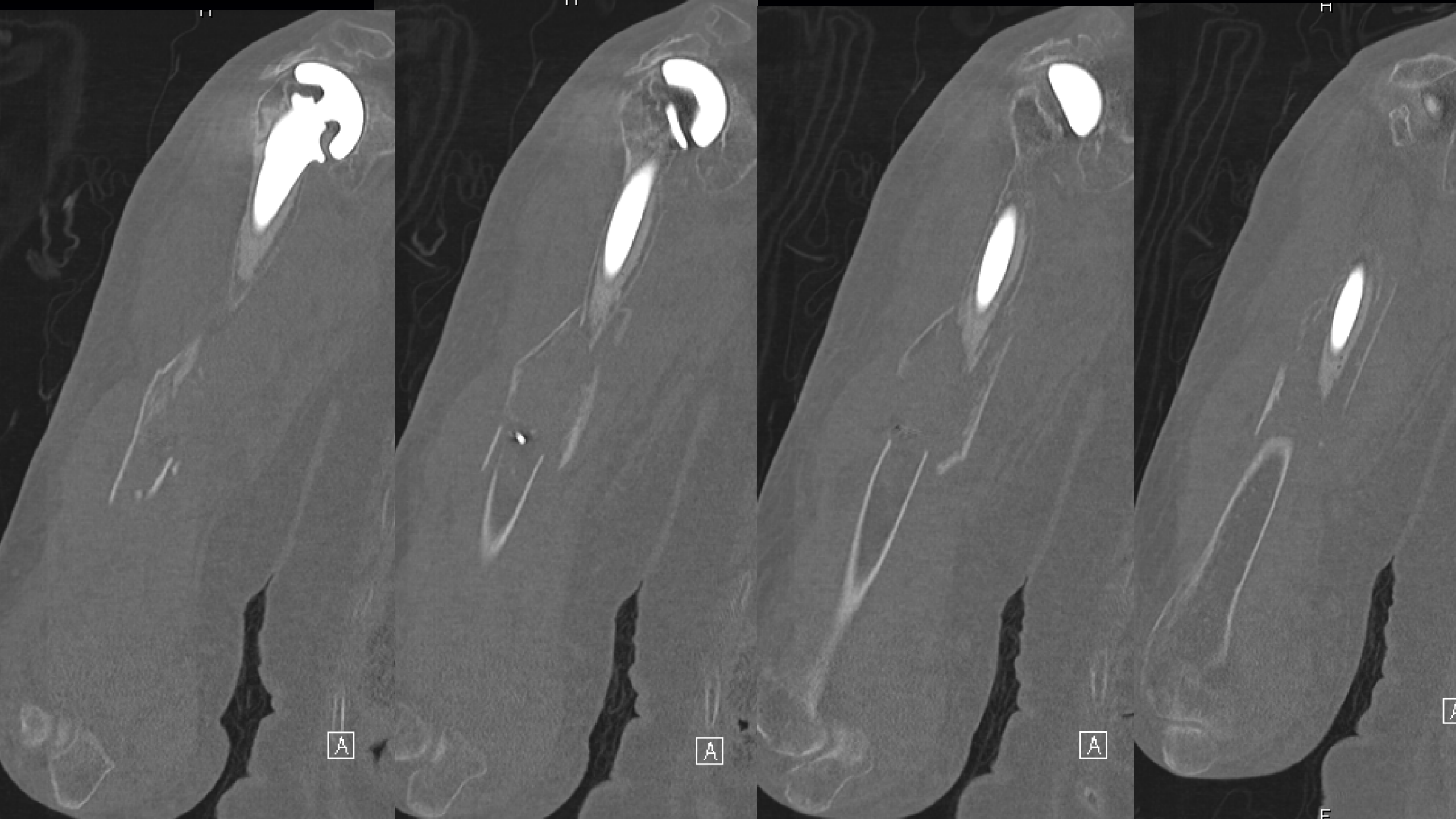


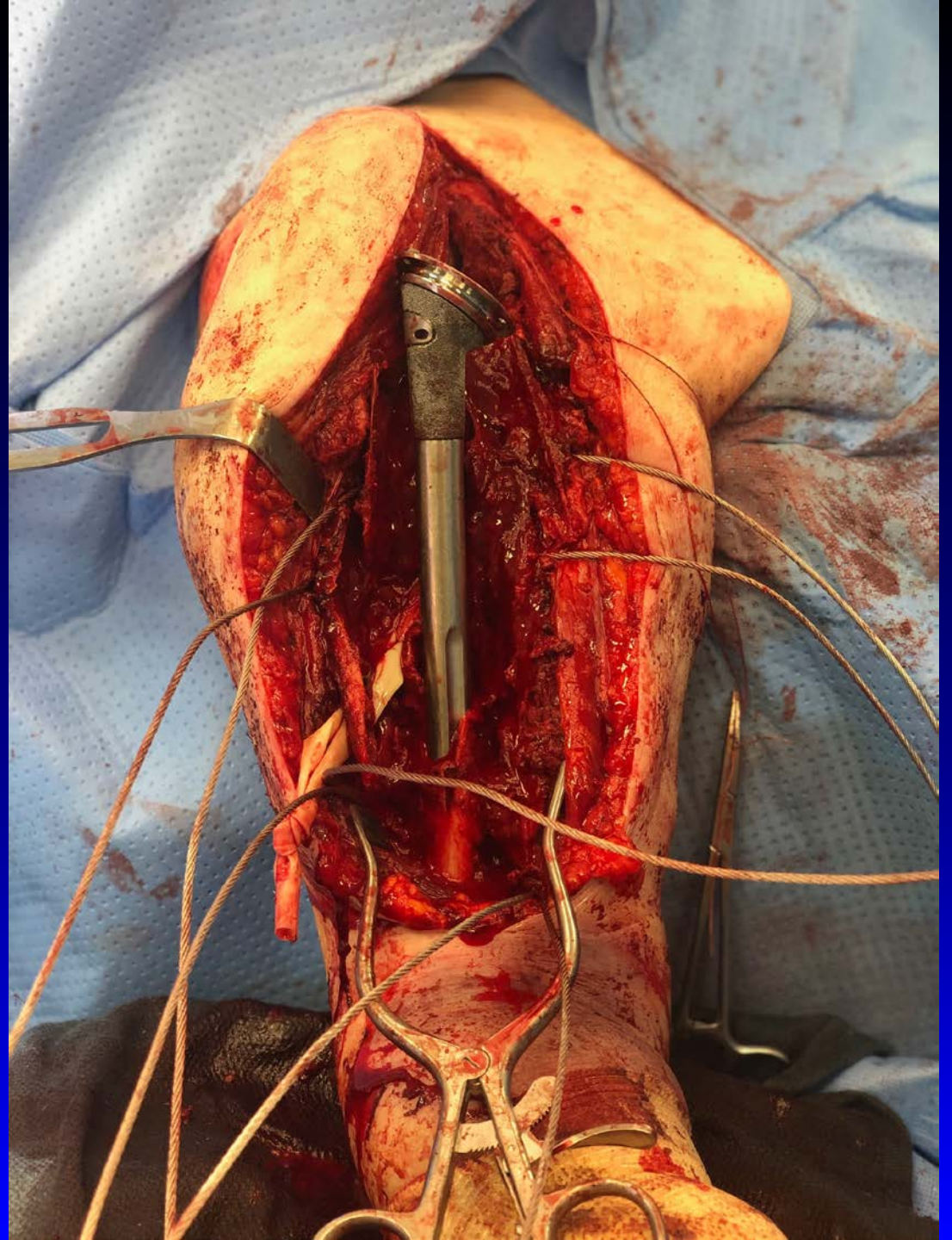
6/1/2021

Case

- 83 F
- Ground level fall
- Right hemi arthroplasty many years ago
- Poor function at baseline







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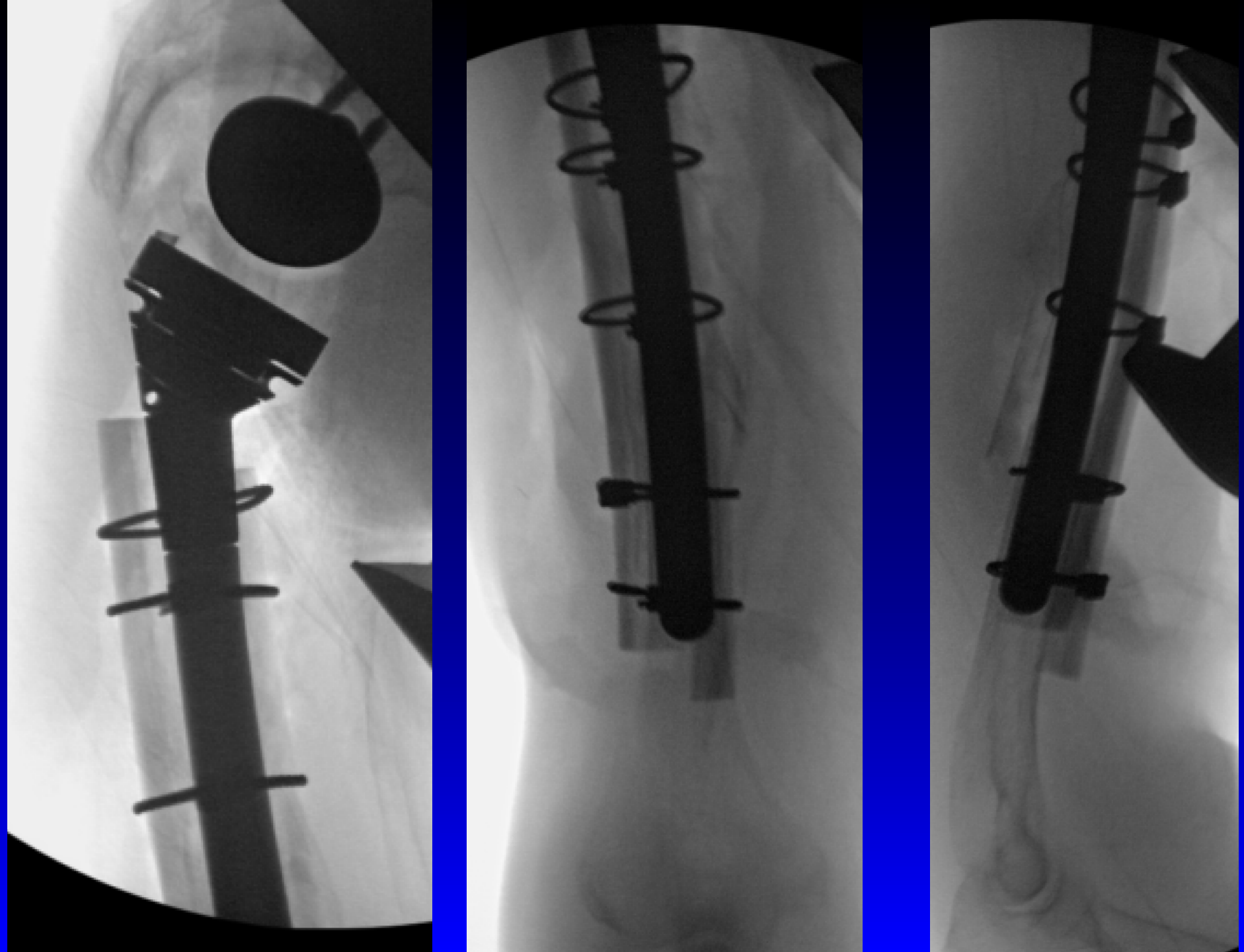
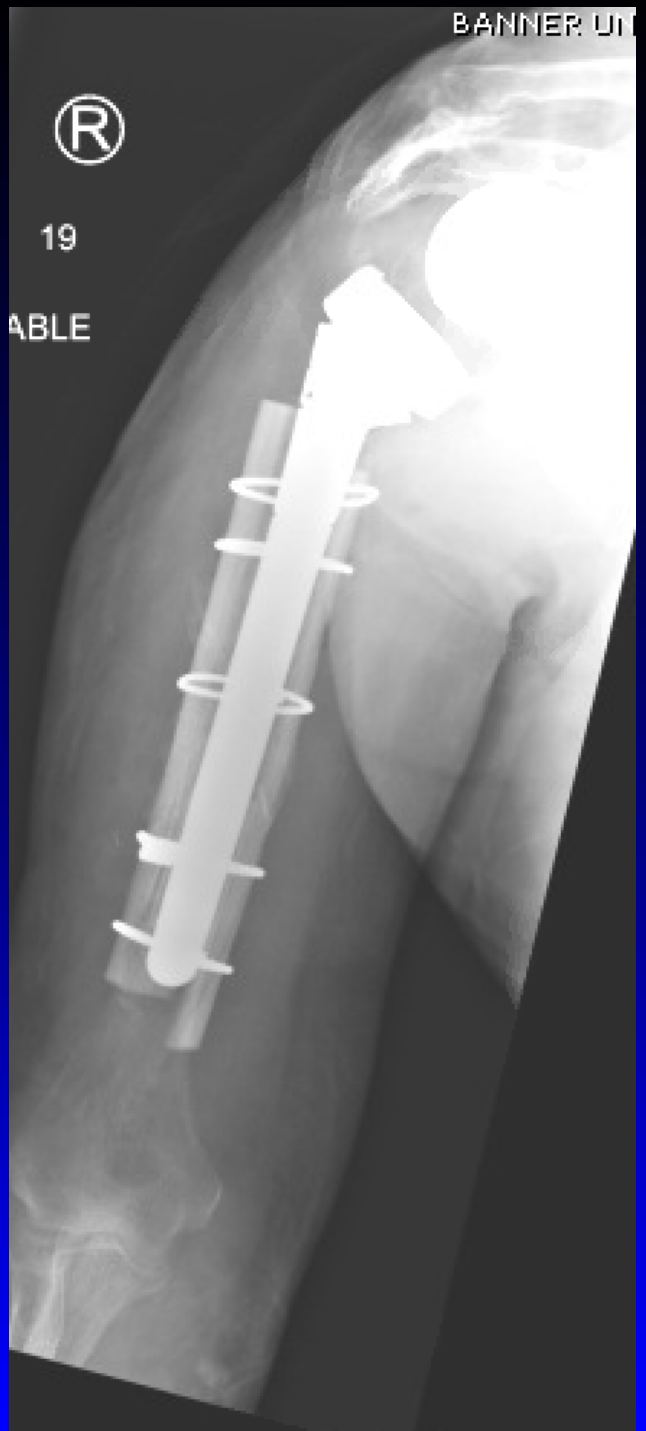
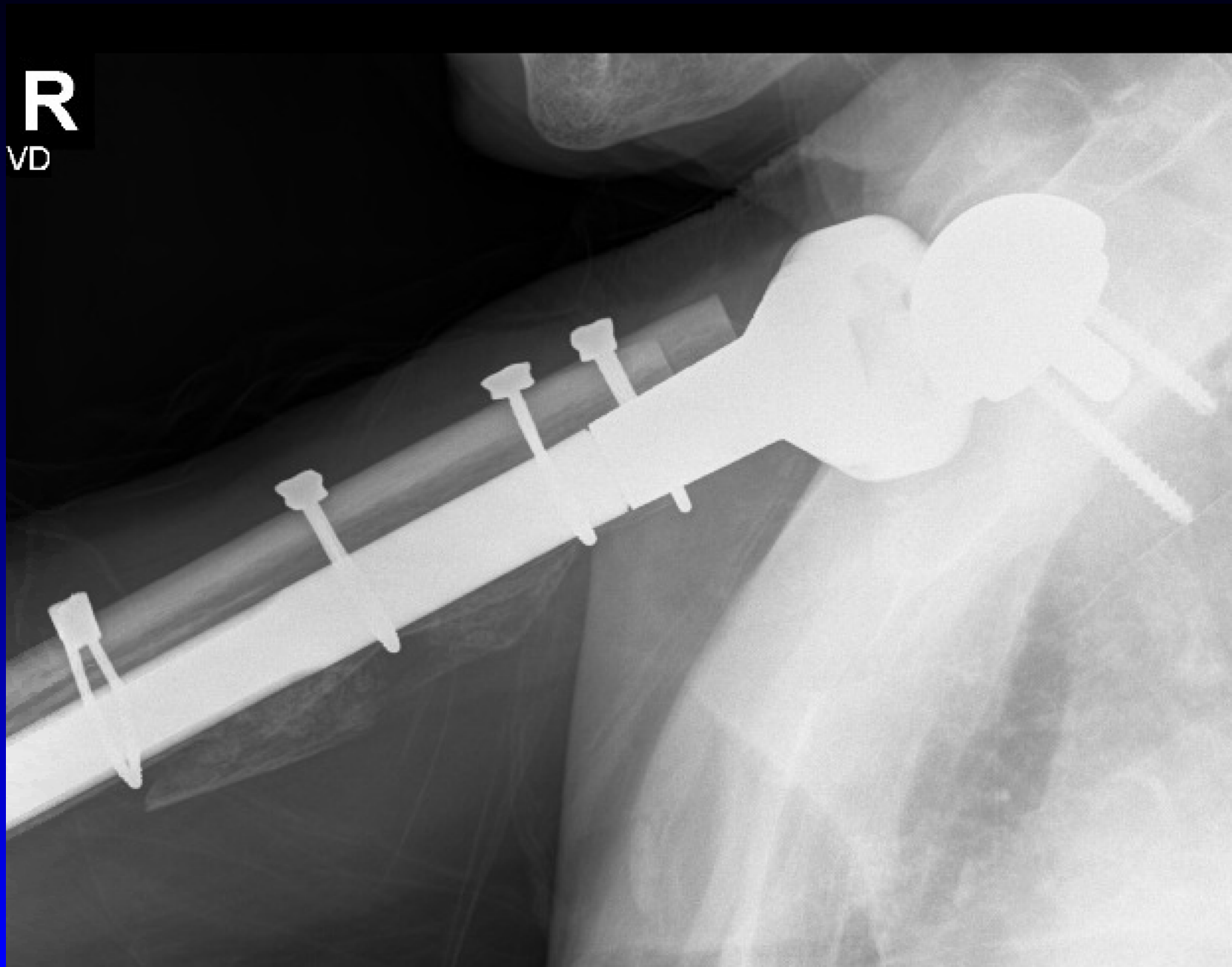




3/31/2020

5/21/2020



Summary

- Periprosthetic fractures are increasing
- Cemented hips have lower risk of revision surgery & intra-op/post-op fractures
- If stem is stable fix the fracture
- If stem is loose need to revise
- Bone health referral

Thanks!

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